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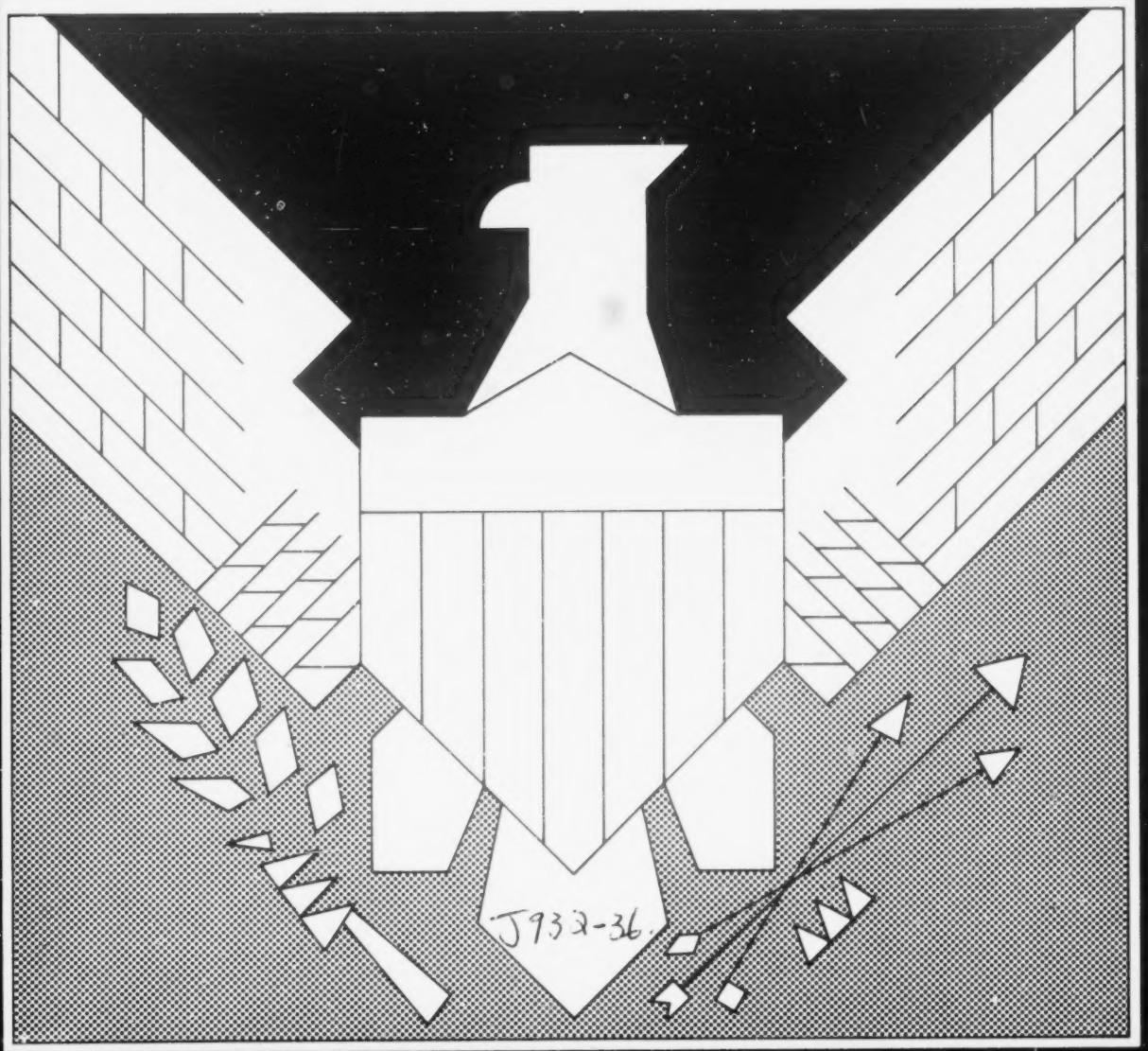
Modernizing the Aerial Tanker Fleet: Prospects for Capacity, Timing, and Cost



CBO STUDY

MODERNIZING THE AERIAL TANKER FLEET: PROSPECTS FOR CAPACITY, TIMING, AND COST

The Congress of the United States
Congressional Budget Office

NOTE

Unless otherwise specified, all costs are expressed in constant fiscal year 1986 budget authority dollars. All dates, except those used in an historical context, refer to fiscal years.

PREFACE

The Air Force has for several years been pursuing programs to modernize and expand the capacity of its aging fleet of aerial tankers, aircraft that support combat bombers and fighters designated for both strategic and conventional missions. While the number and diversity of missions the tanker fleet might support are growing, budgetary pressures have already slowed the progress of modernization efforts. This study, undertaken at the request of the U.S. House of Representatives Committee on Appropriations, Subcommittee on Defense, examines the outlook for continued tanker modernization and improvement. In particular, it compares two alternatives to the modernization effort now being carried out by the Administration. In keeping with the Congressional Budget Office's mandate to provide objective analysis, the paper offers no recommendations.

Bonita J. Dombey, of CBO's National Security Division, prepared the study under the general supervision of Robert F. Hale and John D. Mayer. William P. Myers provided invaluable cost analysis. Jenifer Wishart and V. Lane Pierrot contributed to other aspects of the study. The author owes particular thanks to Johanna Zacharias for comprehensive editorial work. G. William Darr expertly prepared the manuscript for publication.

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SUMMARY

Reflecting the advantages to combat aircraft afforded by aerial refueling--such as extended range, flexibility, and autonomy--most major missions planned for the U.S. Air Force today assign a prominent role to tanker support. But while defense planning has come increasingly to rely on aerial refueling, the tanker fleet itself has diminished in size, from more than 800 aircraft over two decades ago to about 640 today. Furthermore, most of the aircraft in the present fleet are more than 20 years old and suffer from technological obsolescence.

On the basis of its current military planning, the Department of Defense (DoD) places the Air Force's minimal aerial refueling need at the equivalent of 1,000 basic KC-135A tankers ("tanker equivalent" is the unit used in measuring capacity). From this, the present shortfall is estimated to be about 200 tanker equivalents.

Awareness of these problems prompted Congressional action as early as 1979. Efforts to upgrade the tanker fleet are now under way and include the following approaches:

- Modernizing existing KC-135As by replacing their aging J-57 engines with **new CFM-56 engines,** to produce **KC-135R tankers;**

- Similar modernization of KC-135As, but with **refurbished JT-3D engines** salvaged from disused commercial planes, to produce **KC-135E tankers.** (The source of JT-3D engines is commercially owned Boeing 707s, which are now being phased out because of new limits on air and noise pollution.)

- Augmenting the fleet's capacity by procuring new **KC-10 tanker/cargo aircraft.**

The continuing emphasis of the Administration's program for the tanker fleet has been on the first of these approaches. The second approach, mandated by the Congress, has been directed toward tankers in the Reserve forces. For the most part, KC-10s have been procured to expand capacity in the airlift fleet.

COMPLICATIONS IN THE OUTLOOK FOR FUTURE TANKER IMPROVEMENTS

Where should efforts to improve tanker resources go from here? Several factors complicate this question. For one, changes are being made in the fleets of bomber and fighter aircraft that rely on tanker support. For another, the variety of missions in which tanker support would figure is broadening, to include considerable conventional as well as strategic use. These patterns imply increasing pressure for tanker support, especially in the near term. At the same time, though, cost-cutting measures have been slowing efforts to improve tanker resources.

Demand--A Curving Projection That Makes Timing Central

The changing character of aerial combat fleets and the broadening scope of missions involving aerial refueling clearly suggest an increasing demand for tanker support. This is a near-term prospect, however; in fact, demand is expected to peak within only a few years. By the early 1990s, demand should begin to taper off, as the Air Force reduces the proportion of the most fuel-intensive missions for the bombers, introduces larger numbers of more fuel-efficient aircraft and retires many less efficient ones. Timing of tanker improvements, therefore, becomes a central factor.

OPTIONS FOR TANKER FLEET IMPROVEMENT-- MIXES WITH DIFFERENT EMPHASES

By itself, no one of the possible tanker upgrades tested so far would satisfy all concerns. The KC-135R tanker is a powerful aircraft with large fuel-carrying capacity, but lead time between funding approval and delivery is lengthy; moreover, investment costs for the KC-135R are quite high. The KC-135E choice, on the other other hand, can be quite economical and speedy, but it depends on the somewhat uncertain future availability of a supply of "donor" aircraft from which to salvage parts. It also yields the smallest expansion of tanker capacity per aircraft. Reliance on the new KC-10 instead could provide a great deal of capability, but the high investment costs--much more even than those of the KC-135R--would probably be prohibitive without a change of apparent priorities among modernization programs. Furthermore, the Congress may well seek to extend the considerable investment it has already made in KC-135As; this could be done only by the approaches that would modernize aircraft already in the tanker fleet. On the other hand, the Congress may want to invest more moderately in an aging plane that may have a limited remaining useful life.

Because of the harshness of such tradeoffs, the Congressional Budget Office (CBO) has examined options that would mix modernization approaches, in an attempt to moderate the negative aspects of any one choice. The options differ mainly in which approach each stresses. Summary Table 1 illustrates the procurement profiles of the options as they would proceed over the fiscal year 1986-1995 period. Summary Table 2 illustrates CBO's findings.

Option I. The Administration's Plan Emphasizing the KC-135R Tanker

Between 1986 and 1990, the Administration's plan would budget for 287 re-enginings with new CFM-56 engines. Air Force testimony suggests that CFM-56 re-engining would continue beyond the five years for the remainder of the fleet. According to present plans, the Administration would also buy another 20 KC-10 tanker/cargo aircraft, but primarily to improve airlift capabilities, not tanker resources. (These programs would be in addition to the tanker improvement programs already funded, which include re-engining with both CFM-56 and JT-3D engines and the purchase of 40 new KC-10 aircraft--again, primarily for airlift.)

The Administration program would offer the advantage of completing the re-engining of the tanker fleet with the new CFM-56 engine. Plane for plane, the KC-135R is the more capable of the two re-engining alternatives; it also avoids any uncertainties of supply associated with the KC-135E. The CFM-56 is also the quieter of the re-engining choices and offers the better smoke pollution abatement.

On the other hand, since re-engining a KC-135A with the CFM-56 takes about two and one-half years, modernization of the fleet would be slow under this option; only 58 percent of the fleet would be modified by 1990, about the time demand for aerial refueling is expected to peak. Owing to cost and competing priorities, the program is already proceeding at a much slower pace than was envisioned. The fiscal year 1986 Air Force program will fund 89 fewer tankers--from 1982 to 1988--than would the plan that was formulated for fiscal year 1983. This is the result of a consistent pattern. Even at this reduced pace, the current program would cost approximately $6.3 billion in budget authority over the next five years, requiring substantial real growth in funding for tanker improvements, and thus perhaps exacerbating the slowdown.

Option II. Emphasizing the KC-135E Tanker

Modernizing tankers instead with refurbished JT-3D engines would solve some of these problems, because it would be much faster and cheaper than

SUMMARY TABLE 1. PROCUREMENT UNDER THE OPTIONS, FISCAL YEARS 1986-1993

Options and Items Procured	1986	1987	1988	1989	1990	Subtotal 1986-1990	1991	1992	1993	Total 1986 to Completion
Option I										
CFM-56 Re-engining Kits	43	50	50	72	72	287	72	53	--	412
KC-10 Aircraft	12	8	--	--	--	20	--	--	--	20
Option II										
CFM-56 Re-engining Kits	36	36	36	36	36	180	7	--	--	187
JT-3D Re-engining Kits	33	48	48	48	48	225	--	--	--	225
KC-10 Aircraft	12	8	--	--	--	20	--	--	--	20
Option III										
CFM-56 Re-engining Kits	30	30	30	30	30	150	--	--	--	150
JT-3D Re-engining Kits	30	48	48	48	26	200	--	--	--	200
KC-10 Aircraft	12	8	8	8	8	44	8	8	8	68

SOURCE: Congressional Budget Office.

NOTES: Actions up to 1986 include approved purchases of 102 KC-135R re-enginings, 128 JT-3D re-enginings, and 40 of the total planned purchase of 60 KC-10 tanker/cargo aircraft.

SUMMARY TABLE 2. COMPARISON OF THE OPTIONS: CAPACITY, PERCENT MODERNIZED, AND INVESTMENT COSTS, FISCAL YEARS 1986-1995 (Capacity in tanker equivalents, costs in billions of 1986 dollars)

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Option I. The Administration's Plan Emphasizing the KC-135R Tanker										
Tanker Capacity	843	895	912	934	958	989	**1,025**	1,043	1,097	1,105
Percent Modernized	35	40	45	51	58	67	77	87	98	**100**
Investment Costs	1.27	1.13	1.02	1.42	1.45	1.39	0.99	0.03	0.03	0.00
Option II. Emphasizing the KC-135E Tanker										
Tanker Capacity	846	908	934	962	989	**1,011**	1,029	1,038	1,038	1,038
Percent Modernized	37	49	61	73	85	92	97	**100**	100	100
Investment Costs	1.29	1.04	0.93	0.92	0.95	0.18	0.02	0.00	0.00	0.00
Option III. Emphasizing the KC-10 Tanker/Cargo Aircraft										
Tanker Capacity	836	908	958	**1,006**	1,039	1,063	1,082	1,096	1,096	1,096
Percent Modernized	37	49	61	72	85	91	96	**100**	100	100
Investment Costs	1.18	1.30	1.24	1.29	1.24	0.46	0.38	0.22	0.00	0.00

SOURCE: Congressional Budget Office.

NOTES: Actions up to 1986 include purchase of 102 KC-135R re-enginings, 128 KC-135E re-enginings, and 40 of the planned total purchase of 60 KC-10 tanker/cargo aircraft. Numbers in bold type indicate capacity at or above the benchmark demand estimate of 1,000 tanker equivalents, and completed fleet modernization.

the CFM-56 re-engining program. But since it is not certain how many of some 500 potential donor aircraft would be able to be procured from commercial airlines, this option would conservatively include some CFM-56 re-engining. The final breakdown would be 225 KC-135Es and 187 KC-135Rs.

Through 1992, spanning the period when demand is expected to be highest, overall tanker capacity would be modestly higher than if the Administration's plan were followed. This option would provide a capability of 989 tanker equivalents in 1990, compared with 958 under the Administration's plan. Moreover, the pace of modernization would be significantly improved, with 85 percent of the fleet modernized by 1990 and all of it by 1993.

Re-engining with the refurbished JT-3D should not encounter major problems. As considered by CBO, this option would use only about half of the worldwide supply of potential donor aircraft. Nor should logistics problems be major, since the JT-3D is a version of an engine already in use on other Air Force aircraft. Indeed, the Air National Guard has had much better experience with maintaining JT-3Ds than with the old J-57 engines. Finally, the cost of this option over the next five years would be about $5.1 billion, a savings of nearly $1.2 billion compared to the Administration's plan. Total program savings would amount to $3.4 billion.

A clear drawback, however, is that the JT-3D engine cannot provide as much performance improvement plane for plane as can the CFM-56, though under the Administration's option, that disadvantage would be evident only in the 1990s, when demand for tankers should be slackening. Nor can the JT-3D offer as much noise or pollution abatement as can the CFM-56.

Option IIA. Target Additional JT-3Ds for Reserve Forces. Despite its potential lower cost and faster completion, re-engining with JT-3Ds has never been formally supported by the active-duty Air Force, though the Reserve forces have enthusiastically supported it. Funds have already been made available to modernize all 128 tanker aircraft in the Guard and Reserve with the JT-3D. The Congress could pursue additional JT-3D re-engining along these lines by shifting 32 KC-135A tankers (about 5 percent of the fleet) from the active-duty force by eliminating two active-duty squadrons, re-engining the aircraft with JT-3Ds, and redistributing them among Reserve units. This would give additional JT-3D re-engined tankers to the units that have already used them successfully. It would also put at least ten KC-135Es in most Reserve force units and would allow those units to keep two rather than one aircraft on 24-hour alert for the strategic mission. Thus, the ratio of support tankers to alert tankers would improve

from 8 to 1 today to 5 to 1, a more efficient use of assets already owned, and the total number of alert tankers would also increase.

As a first step toward Option II, this variation would save money with the cheaper modification. Total investment savings for the 32 aircraft would amount to about $370 million, compared to the Administration's plan. Additional operating and support costs would eventually erode these savings, but not for many years. Both advantages and drawbacks could follow from such a transfer, such as improved readiness but decreased availability for some missions. With a limited portion of the fleet being transferred, however, pros and cons might not be major.

Option III. Emphasizing the KC-10 Tanker/Cargo Aircraft

The savings achievable by economizing with some cheaper re-engining could be applied to the purchase of 48 more KC-10 tanker/cargo aircraft for use as dedicated tankers. This option would permit tanker improvements to come closer to meeting peak demand around 1990. Both types of re-engining would continue: specifically, 200 tankers would be converted into KC-135Es and 150 into KC-135Rs.

Of all the options, Option III would offer the greatest capacity in the near term. By 1989, the fleet would surpass the benchmark demand of 1,000 tanker equivalents, whereas the Administration's plan would not do so until 1992. By buying a new, modern tanker, Option III would also keep a production line open through the early 1990s, which might be important if the Department of Defense perceives a need for a rapid increase in tanker capacity.

Costs over the five years, however, would be about the same as under the Administration's plan, with higher costs in 1987 and 1988 offset by lower costs in other years. With budgetary constraints prompting cost-cutting actions in so many areas--in particular, measures to slow the growth of defense spending--the high price of Option III might invite the same problems as might the Administration's program. Should future actions slow the pace of KC-10 procurement, the tanker modernization effort could be further weakened in terms of both capacity and timing.

CHAPTER I

THE AERIAL TANKER FLEET IN THE CONTEXT OF PRESENT AND PROJECTED REQUIREMENTS

While the role of in-flight refueling in U.S. defense planning has grown dramatically in recent years, the Air Force's fleet of tanker aircraft has actually shrunk. Tanker aircraft were originally procured to extend the range of the Strategic Air Command's B-52 strategic bomber force; in the interim, their uses have widely diversified. Today, nearly every plane the Air Force purchases for major missions can be refueled while airborne. The Air Force now owns some 10,000 aircraft capable of being refueled while in flight--five times as many as it had two decades ago, when the technique was still relatively new. At the same time, only some 640 aircraft constitute the Air Force's present fleet of dedicated tankers, nearly 200 fewer than 20 years ago.

Furthermore, many of the tankers still in operation are almost as old as the aerial refueling technique itself, which the Air Force pioneered in the 1950s. These are KC-135s, similar to the commercial Boeing 707, and are equipped with four early-generation J-57 jet engines. (A text box on page 2 provides information on tanker aircraft and engines.) Problems of obsolescence and operational limitations combine with sharply rising demand to raise concern about the adequacy of the Air Force's tanker fleet to meet the needs implicit in the Department of Defense's (DoD) wartime plans. Ongoing Administration programs to upgrade the tanker fleet are designed to cost $13 billion through about 1993. But despite overall growth in defense spending, the allotment for tanker modernization has been trimmed. This study examines the advantages and drawbacks associated with various mixes of choices for modernizing and expanding the U.S. tanker fleet. The study considers the choices in the context of the Administration's plans and trends in demand for tanker support.

TODAY'S TANKER FLEET-- PROBLEMS, ATTEMPTED SOLUTIONS, AND DIVERSE MISSIONS

Despite the diversity and magnitude of its assignment, the KC-135 is still able to continue safe flying. A program now under way to improve the

AIRCRAFT AND ENGINES IN THE AERIAL TANKER FLEET

The original aircraft in the fleet, **the KC-135**, was introduced in 1957 and today remains the Air Force's mainstay tanker. Built by the Boeing Corporation until the mid-1960s, the KC-135 is similar to the same firm's civilian-service 707. Referred to now as **the KC-135A**, the basic tanker has a fuel-delivery capacity of 63,000 pounds for an average mission distance of 2,500 nautical miles. It is equipped with four early-generation **J-57** jet engines, manufactured by Pratt and Whitney, complemented by water-assisted thrust for take-off. Modified with other engines, this basic tanker takes on new designations. KC-135 is also used as an umbrella term applying to all tanker aircraft with like bodies, regardless of modifications.

Refitted with a **brand new CFM-56 engine** now being procured from Consolidated Fan Motors, Inc., a company formed jointly by the General Electric Corporation and SNECMA, a French firm, the KC-135A tanker is redesignated the **KC-135R**. Thus modernized, the KC-135R can deliver 94,500 pounds of fuel at the same flying radius of 2,500 nautical miles.

Refitted instead with a **refurbished JT-3D engine**, the basic tanker becomes the **KC-135E**. The JT-3D, built by Pratt and Whitney and no longer being manufactured, is salvaged from Boeing 707s now being phased out of commercial service. The improved fuel-delivery capacity of the KC-135E is 75,600 pounds at 2,500 nautical miles.

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The only altogether new aircraft in the fleet, the **KC-10 tanker/cargo aircraft** is currently being procured from the McDonnell Douglas Corporation. At the same flying distance of 2,500 nautical miles, the KC-10 has a fuel-delivery capacity of 162,000 pounds.

NOTE: Chapter II details other characteristics of these four aircraft.

wings of the entire fleet--to be completed in fiscal year 1987 at a cost of about $528 million (in current dollars)--guarantees the structural viability of these aircraft well into the next century. 1/ But aging technology does create and exacerbate operational problems, most centering on the KC-135's engine.

1. For further background on ongoing modernization efforts, see Congressional Budget Office, *Aerial Tanker Force Modernization* (March 1982).

Today about 150 KC-135s have been modified with new or refurbished engines and other improvements. (These modifications are detailed in Chapter II.) The remainder still have old, first-generation J-57 engines; these are designated KC-135As. The limited thrust from the J-57 engines means dependence on long runways--more than 10,000 feet at maximum gross takeoff weight (297,000 pounds). Even from long runways, KC-135As rely on demineralized water for a mechanically troublesome water-injection system that provides additional thrust for takeoff. Both the runway and water requirements limit geographical access and/or impose fuel-capacity constraints, and thus they hamper the tankers' operational flexibility and fuel-carrying capacity. For instance, the water-injection takeoff system limits operation of KC-135As in places where demineralized water is scarce, such as some parts of the Middle East. In the United States, costly water-processing facilities and tank trucks are located at bases with permanently assigned KC-135As. During the winter, water must often be heated; at air temperatures below 20 degrees Fahrenheit, water must be drained from the aircraft so it will not freeze in the engines before or during takeoff. Moreover, even with water injection, in many places the KC-135A cannot take off with a maximum fuel load for lack of sufficient runway length.

According to the Air Force, the J-57 engine on KC-135As is also becoming more expensive to maintain. Its upkeep requires more man-hours per flight hour than do any of the re-engined aircraft. But its performance statistics are still generally good, because money is being spent to replace the components that have shown the most deterioration. 2/ The cost of these repairs for the total fleet is about $135 million (in fiscal year 1984 dollars), of which roughly half has been spent to date. If these aircraft continue to operate into the 1990s, more complete overhauls may be needed.

Many of these problems will be resolved with the re-engined aircraft described in Chapter II. The Air Force is also beginning to receive 60 new KC-10 tanker/cargo aircraft, which are being bought primarily to correct a shortfall in airlift capacity. Today, however, the tanker fleet still consists mainly of unmodified KC-135As.

Because the requirements planned for use of the tanker fleet will determine the success of ongoing, planned, or proposed efforts to upgrade it,

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2. These include improvements to or replacement of the turbine area, fuel manifold, combustion case, and compressor blades.

the remainder of this chapter details the demands placed on the fleet. 3/ These demand projections underlie the Congressional Budget Office's (CBO) analysis of possible options for improving aerial refueling resources.

Features Stimulating Tanker Demand

Planning by DoD reflects the fact that any military plane, whether conventional or strategic, combat or support, gains several clear advantages if it can be refueled in midflight. One, of course, is *extended range.* An obvious associated benefit is *promptness.* For example, fighters deploying from Langley Air Force Base in Virginia to Dhahran, Saudi Arabia, can get there in 15 hours non-stop with air-refueling rather than 47 hours by landing en route to refuel. Another benefit is *security,* because basing for combat aircraft can usually be kept to safe areas. 4/ Still others are *flexibility* and *autonomy;* aerial refueling obviates the need for combat planes to follow routes with midcourse, land-based refueling stations and avoids reliance on other nations' cooperation. Finally, aircraft fueled in flight are spared the wear and tear associated with extra landings and takeoffs.

Complicating matters, and indicating that pressure on tanker resources will continue to mount, is tanker aircraft *versatility.* Support of the strategic bomber force--today some 300 aircraft--is still the first-priority mission of the entire KC-135 tanker fleet, and the one that consumes by far the most resources. To this end, about 30 percent of the aircraft and their crews "stand alert" around the clock, ready to take off and execute their missions within minutes of notification. The nearly 200 tankers on daily alert are not available for other missions. 5/

In addition to their primary role of supporting strategic bombers, tankers today are also relied on heavily to support most air missions--including conventional bombing, tactical fighter deployment and employment, and airlift operations. Tankers are also used in many day-to-day operations worldwide, including support of training and military exercises and a wide

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3. The Defense Guidance (DG) scenario guides general-purpose force planning, while the Single Integrated Operational Plan (SIOP) guides strategic nuclear force planning.

4. Basing is not always limited to safe areas, since other considerations such as peacetime training must also be addressed. With aerial refueling, however, the option exists to disperse aircraft to safe bases in times of heightened tensions.

5. Normally, about 5 percent of the tanker fleet is in the maintenance "pipeline." Tankers on daily alert represent about 30 percent of the 615 Primary Authorized Aircraft (PAA) --those not in the pipeline.

variety of other military tasks. For instance, tankers support military cargo aircraft carrying supplies and equipment to remote areas such as in Europe and South America. In Saudi Arabia, U.S. tankers support Airborne Warning and Control System (AWACS) aircraft in their ongoing surveillance effort to stabilize the Persian Gulf region.

PROJECTED DEMAND FOR TANKER RESOURCES

Trends in demand for tankers for both the near and long term can influence the choice of how to improve the fleet and when. The demand projection is a dynamic not a steady one, shifting as a result of changes in force structure and force use, as well as general U.S. defense policies and commitments. Four primary factors are influencing demand for tanker capacity:

- A growing proportion of conventional military aircraft now equipped and slated for in-flight refueling,
- A near-term increase in fuel-demanding missions for the strategic bomber force,
- The Air Force's procurement of newer, more fuel-efficient aircraft, and
- The United States' commitments to its allies.

Trends indicate that current tanker resources probably fall short of today's demand as determined by Air Force estimates. In the near term, demand is likely to continue to grow. Then, however, it may well decline somewhat, with the shift occurring around 1990. Efforts to address the problem of tanker "shortages" should therefore take into account this early peaking and later tapering of demand.

Pressure from the Strategic Forces--An Increasing and Receding Pattern

Demand for tankers to support strategic forces will likely rise in the next few years, increasing the tanker shortfall. By the end of the decade, however, tanker demand should decline. This pattern primarily reflects changes in anticipated numbers of bombers in Air Force inventories and the missions assigned to them.

As part of the Administration's plans for the strategic forces announced in October 1981, the bomber force is being modernized with two

new aircraft: 100 B-1B bombers are currently being fielded; 132 Advanced Technology Bombers (ATBs) incorporating "stealth" radar-evading technologies are planned to be fielded starting in the early 1990s. 6/ The ATB is considered necessary to maintain the ability to penetrate upgraded Soviet air defenses. After the Air Force introduces many of these new bombers, it will gradually retire the aging B-52s. In the interim, however, there will be more bombers than there are today, pushing up tanker demand in the coming few years.

The types of missions planned for strategic bombers will also exert pressure on demand in the near term, but in later years, that pressure is seen to diminish. B-52 bombers are being modified to carry cruise missiles (relatively small missiles able to be released from aircraft at long ranges and to travel to their targets on their own power). All B-52G models have been modified by now, and plans are proceeding to modify the B-52Hs. All B-1Bs are planned to be able to carry cruise missiles, but ATBs are not planned to carry cruise missiles.

The missions designated for B-52s carrying cruise missiles will proceed in two phases. The first--called the "shoot-and-penetrate" mission--involves installation of cruise missiles on pylons under the wings, with the internal bomb bays remaining loaded with short-range weapons. The bomber first launches the cruise missiles before entering enemy airspace and then continues at low altitudes to launch short-range weapons.

The shoot-and-penetrate profile calls for a lot of fuel, because the bomber is to be heavily loaded before releasing its cruise missiles, and then it must be able to fly long distances at low altitudes (at which jet engines are inefficient) to release its short-range weapons. The external cruise missiles also significantly increase the air resistance ("drag") the aircraft faces. According to an earlier CBO study, average tanker requirements increase by 34 percent for each bomber affected. 7/ This mission is most prominent through the 1980s, substantially increasing the demands on the supporting tanker force. Figure 1 shows how strategic bomber force missions will evolve over the coming 10 years in light of Administration plans.

The second mission, which B-52 bombers will begin to assume in the late 1980s, will reduce tanker requirements. This mission involves cruise-

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6. See remarks of Senator Carl Levin, *Congressional Record*, December 3, 1982, p. S14378.

7. Congressional Budget Office, *Aerial Tanker Force Modernization*, page 14.

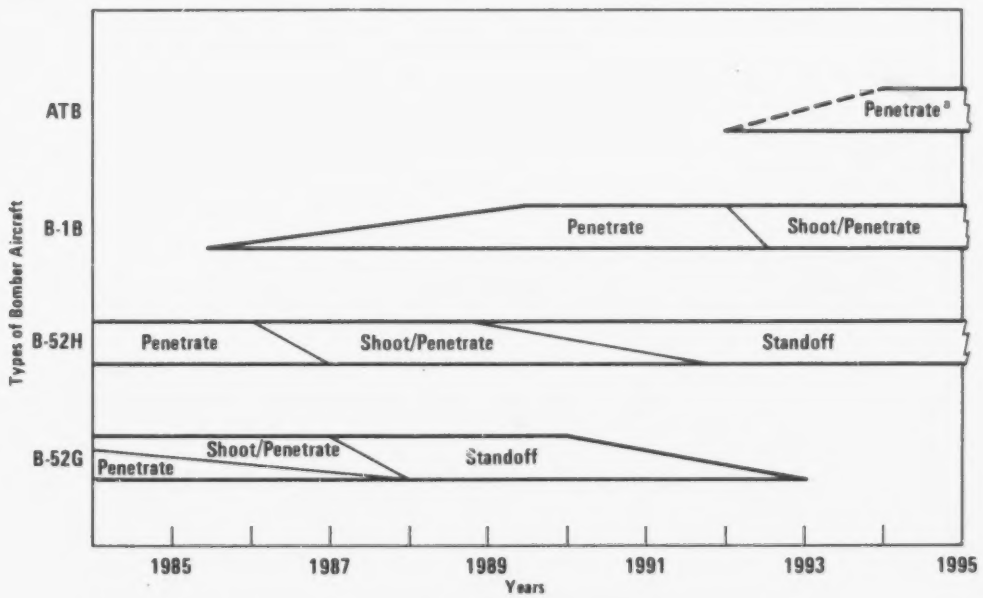
missile carriage only. By then, these bombers would not carry short-range weapons that require flight in enemy airspace, because Soviet air defenses are presumed to be too taxing for B-52 operations. Since these so-called "stand-off" bombers capable of launching long-range missiles could avoid long flight at low altitude, fuel requirements--hence demand for tanker support--would decline substantially.

Strategic force demand for tankers is seen declining in the 1990s for other reasons as well. By then, the bomber force will consist of fewer and more fuel-efficient aircraft because of modernization efforts now under way. According to Air Force estimates, new engines on the B-1 will generally be more fuel efficient than those of the B-52. Fuel efficiency of the ATB should be at least as good as that of the B-1.

Pressure from the Conventional Forces--A Similar but Less Certain Pattern

Demand for tanker support for conventional forces is harder to project. Whereas strategic nuclear missions are based on quite detailed plans de-

Figure 1.
Development of U.S. Strategic Bomber Force Missions Projected to Fiscal Year 1995



SOURCE: Congressional Budget Office, based on Department of Defense information.

[a] Initial introduction of the Advanced Technology Bomber is planned for the early 1990s.

signed to change little once an attack begins, conventional missions are far less prescribed and are subject to spontaneous adaptation to circumstances.

In DoD plans stressing rapid force projection abilities for the conventional forces, the role of aerial refueling has been growing substantially in recent years, figuring prominently in plans for a conventional NATO conflict in Europe as well as for contingencies elsewhere. Current objectives for U.S. support of the NATO allies call for moving six Army divisions and 60 tactical fighter squadrons to Europe within the first ten days of a war. 8/ Tanker support would figure heavily in meeting those goals. Tankers would serve not only to support fighters and transports on the way to a theatre of combat, but would also augment operations of tactical fighters. With aerial refueling, fighters running low on fuel but still carrying unexpended weapons could continue their missions. Other aircraft, such as long-range surveillance AWACS and conventional bombers, would also rely on inflight refueling.

Though the effects on tanker demand of conventional forces are less clear than for strategic forces, they tend to reinforce the near-term increase and long-term decline noted above. Tactical fighter forces, which account for most conventional-force demand for tankers, are planned to expand from the current 36 wings to 40 by 1991, an increase of about 300 aircraft. (Plans for this expansion, however, have been delayed each year since 1982.) Moreover, the composition of those forces is slated to change dramatically. The fuel-inefficient F-4 fighters introduced in the 1960s--each requiring one tanker just to cross the Atlantic, rather than one tanker per several new F-15 fighters--currently make up about 30 percent of the tactical air forces. By 1991, however, according to Administration plans, F-4s would account for only about 7 percent. (Figure 2 shows the planned composition of the tactical fighter force over time.) Thus, the conventional forces' demand on aerial tankers could decline, complementing the likely decline in demand from strategic forces.

Benchmark for Tanker Demand

Though official tanker requirements are classified, rough estimates are publicly available. Tanker requirements are usually stated in "KC-135A equivalents," using the fuel-delivery capacity of the current tanker as the basis for comparison. 9/ Thus, a KC-135A equals one tanker equivalent. A modified

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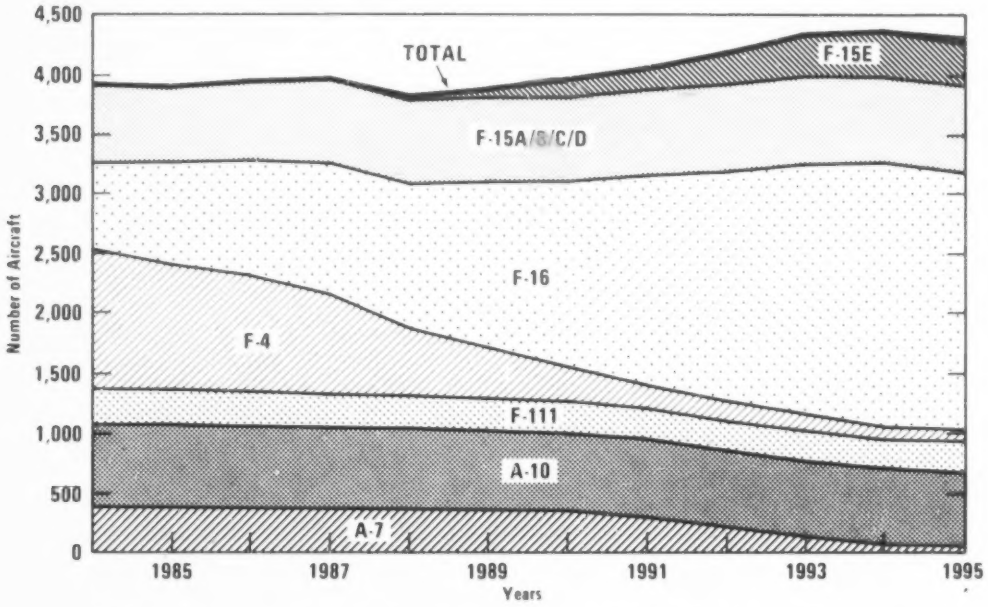
8. Department of Defense, *Annual Report to the Congress, Fiscal Year 1985*, p. 175.

9. Fuel-delivery capacity varies as a function of distance from takeoff base. The capacity of the KC-135A for an average mission--63,000 pounds at a 2,500 nautical mile radius--is used as the analytic baseline for comparing tanker capacity improvements.

Figure 2.
Development of U.S. Tactical Air Forces Projected to Fiscal Year 1995



SOURCE: Congressional Budget Office, based on data provided by the U.S. Air Force.

KC-135R, with its new engine increasing fuel-delivery capacity by 50 percent, represents 1.5 tanker equivalents. Still another modification with a refurbished engine, the KC-135E, is valued as 1.2 tanker equivalents. The new KC-10 aircraft capability is expressed as three tanker equivalents. (Table 1 in Chapter II gives further details on the tanker modifications.)

A Department of Defense response of March 1984 to a study by the General Accounting Office (GAO) states that "... the DoD knows that at least 1,000 tanker equivalents are required, and depending on events and future weapon system needs, significantly more may be required." 10/ Thus, in this analysis the CBO has used 1,000 as a lower bound for what DoD believes is currently required, although peak tanker requirements may rise

10. DoD response of March 16, 1984, to GAO report, "Potential for Reducing Costs by Using More JT3D Engines in the KC-135 Reengining Program (GAO/NSIAD-83-47)," September 23, 1983, p. 7.

well above this level. Below that level, the risk would be highest of having to divert tanker resources dedicated to the strategic mission to meet conventional demand.

Using the above capacity ratios, *current tanker fleet capacity is now about 800 KC-135A equivalents*--about 200 short of the lower bound.

CHAPTER II

APPROACHES TO MEETING TANKER NEEDS

Efforts to modernize and expand U.S. aerial refueling capacity are under way. To date, the Air Force has taken three general approaches. Two involve re-engining and otherwise improving the performance of existing KC-135A tankers. The third involves procurement of a new tanker/cargo aircraft, the KC-10. (Table 1 gives comparative details on all aircraft.) The relative costs of these methods differ considerably, as do the improvements they can yield, and the speed with which they can be accomplished.

APPROACHES TO MODERNIZATION

Between 1977 and 1985, $2.7 billion was budgeted for re-engining the tanker fleet's KC-135As and $3.3 billion (in current dollars) for procurement of KC-10s. Under contracts initiated through 1985, the Air Force will have funded 230 re-engined tanker aircraft and will have procured 40 KC-10s.

Re-Engining with the CFM-56--the KC-135R Tanker

According to the Air Force's preferred course, the old J-57 engines on unmodified KC-135As are being replaced with a new, higher-thrust turbofan engine designated the CFM-56. Both the current J-57 engines and the constraining water-injection system described in Chapter I are being replaced with this modification. The program also includes modernization of a number of systems and subsystems, including strengthened main landing gear, auxiliary power units and some new instrument and control systems. Most of these other modifications were required to accommodate the aircraft's more powerful CFM-56 engines, which also increase its fuel-carrying capacity. The result, according to the Department of Defense, will be a KC-135R able to deliver, on average, 50 percent more fuel than can its predecessor. Part of this increased delivery capacity can be attributed to a 27 percent improvement in the engine's fuel efficiency. 1/

1. Estimates here and elsewhere are based on average fuel-delivery capacities of the aircraft at specified distances, and are quite sensitive to the ranges and diversity of missions.

TABLE 1. OPERATIONAL AND SUPPORT CHARACTERISTICS OF FOUR TANKER AIRCRAFT

	KC-135A	KC-135R	KC-135E	KC-10
Operational				
Maximum Gross Weight (in pounds)	297,000	322,500	299,000	590,000
Fuel Load at Maximum Gross Weight (in pounds)	189,700	202,800	189,700	359,000
Takeoff Distance at Maximum Gross Weight (in feet, at 90 degrees Fahrenheit)	11,200	8,100	9,600	8,800
Fuel Delivery Capacity at 2,500-Nautical-Mile Radius (in pounds)	63,000	94,500	75,600	162,000 a/
Fuel-Efficiency Improvement Relative to KC-135A (in percents)	--	27	14	b/
Smoke Pollution Reduction Relative to KC-135A (in percents)	--	92	74	b/
Compliance with Commercial Noise Standards	No	Yes	No	Yes
Support				
Maintenance Man-Hours per Flight Hour (engine only)	3.20	0.70	1.00	c/
Engine Removal Rate (per 1,000 Flight Hours)	0.83	0.28	0.41	c/

SOURCE: Congressional Budget Office from data provided by U.S. Air Force.

a. At longer mission distances, the ratio of fuel delivered by the KC-10 relative to the KC-135A's increases significantly.

b. Not directly comparable to the KC-135A.

c. Logistic support for the KC-10 is being managed by McDonnell Douglas and does not have comparable statistics. However, the aircraft is exceeding all contractual requirements regarding reliability and maintainability.

In addition, even with its greater fuel-delivery capacity, the KC-135R requires a much shorter runway for takeoff. This, along with ended reliance on water-injected thrust, improves the basing and flight flexibility of the aircraft. According to the DoD, the KC-135R can, for instance, operate from 130 more airfields in the United States than can the KC-135A. 2/

The KC-135R program does have an important initial drawback. The "lead time" for the KC-135R--the span from funding approval to delivery of the re-engined aircraft--is about two and a half years. As of September 1985, only some 28 KC-135Rs have been delivered to the fleet. Budgetary restrictions account for the lag. When new aircraft are procured, long-lead-time items, such as engines and landing gear, are bought in advance of funding approval for the full aircraft; the aim is to minimize the time from full funding approval to delivery. Modification programs, however, are not subject to advance procurement. 3/ Because of its lengthy lead time, reliance on the CFM-56 re-engining program significantly affects the near-term prospect for modernizing and adding capacity to the fleet.

The Air Force program currently calls for funds for re-engining 287 aircraft through the five-year plan (1986-1990), at a total cost of about $5.7 billion. 4/ The average cost for the re-engined KC-135R (not including research and development) is $20.8 million per aircraft. Annual operating and support costs are $2.3 million per aircraft. (Operating costs include fuel, maintenance, and pay for crew and other direct and support personnel. Obviously, this figure can fluctuate widely with fuel costs and annual numbers of flying hours.) 5/

Re-engining with the JT-3D--the KC-135E Tanker

Another re-engining approach--a quicker and cheaper one--has also been undertaken, namely to salvage and refurbish JT-3D engines and related equip-

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2. The DoD response of 16 March 1984 to General Accounting Office final letter report: "Potential for Reducing Costs by Using More JT-3D Engines in the KC-135 Reengining Program," dated September 23, 1983, p. 2. The Air Force explained in more detail that, while most of these airfields could not support peacetime tanker operations, they could be used for emergency situations requiring force dispersal for safety.

3. One exception can apply in the case of multi-year funding, which requires a commitment for given quantities over several years. The Air Force requested approval for multi-year funding for the KC-135R in fiscal year 1984, but the request was not approved by the Congress.

4. This total includes obligations occurring beyond 1990 for installation of the kits.

5. Numbers here and elsewhere in the study assume 305 hours of flying per year per active force tanker and $0.94 per gallon fuel prices, based on Air Force data.

ment from Boeing 707s retired from commercial service. Commercial operators are retiring these planes because they fail to meet the Federal Aviation Administration's (FAA) noise and emissions standards effective in U.S. airspace as of January 1985. 7/

Because it exploits existing aircraft of little economic value in civilian markets, this modification is substantially less expensive for the military than procuring new engines. At the same time, the JT-3D modification is far narrower in scope than CFM-56 re-engining. It does not include new auxiliary power units, for example, or new generators. (Other points of comparison between the two re-engining programs are detailed opposite.)

The average cost for the JT-3D re-engined aircraft, designated the KC-135E, is $4.1 million--about one-fifth the cost of the KC-135R. Annual operating and support costs for the KC-135E are about $2.3 million per aircraft, the same as for the KC-135R, but in times of rising fuel prices they could be higher. 7/ The JT-3D engine may also incur the added expense of a major overhaul after 15 years, adding another $250,000 per aircraft (in fiscal year 1985 dollars). 8/ In contrast, the CFM-56 engine is not expected to need a major overhaul over the system's life.

According to DoD estimates, the JT-3D modification will yield a KC-135E tanker with fuel-delivery capacity improved by an average of 20 percent over its predecessor, attributable in part to an increase of about 14 percent in its own fuel efficiency. Like the KC-135R, the refurbished E version will require a shorter takeoff distance and so will have access to more airfields. The incorporation of thrust reversers will also give the KC-135E some landing ability that the costlier KC-135R lacks. (Thrust reversers redirect engine output to help stop an aircraft during landing. With them, a KC-135E on an icy runway could land with more fuel remain-

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6. Federal Aviation Regulations, Part 36.

7. Operating and support costs for the KC-135E are estimated to be about $0.04 million more than for the KC-135R. KC-135E operating costs include more for fuel than the KC-135R; thus, rising fuel prices would make operating and support of the KC-135E more expensive relative to the KC-135R.

8. The refurbished engine is expected to operate about 6,000 hours before requiring a major overhaul. That translates to about 15-20 years of operation, depending on whether the aircraft is being flown in the active force or Reserve forces--which fly more hours.

KC-135R	KC-135E
Adds new engine instruments	Adds used engine instruments
Has no thrust reversers	Has thrust reversers
Adds fire detection/extinguishing system	--
Adds turbine engine monitor	--
Adds new generators	Adds used 707 generators
Adds new airbleed system	--
Adds dual auxiliary power unit for quick start	Adds cartridge start system
Adds new series yaw damper	Adds 707 yaw damper
Adds flight control augmentation system	--
Adds new rudder actuator	--
Adds strengthened main landing gear	--
Adds rudder pedal controlled nose steering	--
Adds new air data computer	--
Reduces smoke pollution below KC-135A by 92 percent	Reduces smoke pollution below KC-135A by 74 percent

IMPROVEMENTS COMMON TO BOTH AIRCRAFT

Removal of water injection system
Enlarged horizontal stabilizer
Addition of 5-rotor brakes
Addition of Mark III antiskid system

ing--which makes the aircraft heavier and harder to stop--than could a KC-135R, which lacks thrust reversers.) 9/

9. The commercial version of the CFM-56 engine has thrust reversers, but owing to cost and weight considerations, coupled with the lack of a stated requirement, the Air Force chose to have them removed in the military version of the engine. On an icy runway, with 10,000 pounds of fuel remaining, thrust reversers enable the KC-135E to land on a 5,565-foot runway, while the KC-135R requires 6,450 feet. The runway length requirements for takeoff (at mission effective weight), however, greatly exceed those for landing for both aircraft, and the KC-135R can take off from a somewhat shorter runway than the E version. Thus it would be difficult to quantify any operational advantage provided by thrust reversers; however, they do provide an added margin of safety and for that reason, they are found on all commercial aircraft. According to the Air Force, the cost of incorporating thrust reversers on future modifications would be $2.5 million to $3.7 million (in fiscal year 1984 dollars) per aircraft.

Both re-engining modifications allow removal of the troublesome water-injection system, significantly improving geographical flexibility. Unlike the CFM-56 engine, however, the JT-3D does not meet the new U.S. noise and emissions standards. Although the military is exempt from these regulations, the KC-135R with its new engine will comply with them.

Ultimately, KC-135E re-engining may be limited by the supply of "donor" Boeing 707 aircraft, the source of components for the modification. Interestingly, though, there is no constraint on the supply of engines, since a surplus of engines is now available. But other parts, such as some cockpit instruments, must come from the donor 707s. The remaining supply of donor aircraft now totals about 500 worldwide, and most are owned by non-U.S. airlines. How many of these 500 aircraft are or will be available remains uncertain. In 1987, the International Civil Aviation Organization will adopt the environmental regulations now in effect in the United States, which may greatly increase the availability of donor aircraft.

Several companies, however, have begun manufacturing "hush kits," to bring 707s into compliance with the new noise abatement regulations; this may dampen the prospects of a substantial future supply of donor aircraft. Hush kits reportedly sell for between $2 million and $3 million. 10/ Although demand for the kits has not been very strong to date (fewer than 100 kits have been sold so far), it is not clear how many of the 500 potential donor aircraft may become unavailable to the military by using hush kits to remain in commercial service. The kits may also raise the cost of donor aircraft, since the sellers would now have an alternative use for them. Nonetheless, it seems likely that a substantial number of aircraft would be available at costs well below those of the CFM-56, if the Administration and the Congress chose to act quickly and pre-empt private-sector competition.

Moreover, because the KC-135E modification uses existing parts and is less comprehensive than the KC-135R modification, lead time is also significantly shorter--less than six months, compared to two and one-half years. Thus, the E model is available to the fleet much sooner, which may be important in addressing near-term demand.

The active-duty Air Force has expressed concern about the condition of foreign-owned 707 aircraft engines and instruments. According to an unofficial spokesman for the FAA, however, all Boeing aircraft available worldwide were built to meet U.S. aviation standards, and all but a few have

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10. For details, see *Aviation Week and Space Technology* (November 12, 1984), pp. 157-160.

probably received continued care and maintenance in accordance with international civil aviation standards. Furthermore, any lapses in maintenance are far more likely to have had a deleterious effect on the engines than on the airframes themselves. Since there is a surplus of engines, if an aircraft were found to have unsuitable engines, other engines could be substituted, with the airframe components still coming from donors.

The active-duty force has raised other concerns, namely potential maintenance and support problems. Since the JT-3D engines come from many sources, there is more variation among the parts than if they had all been operated and maintained by the same user. This potentially makes them more difficult than new engines to maintain and support. The JT-3D, however, is basically the same TF-33 engine currently in the active-duty force on B-52H bombers, as well as on other Air Force aircraft; 80 percent of the JT-3D engine parts are common with these engines and are listed in federal stock. Spokesmen at the Air Force Logistics Center which manages KC-135 depot maintenance say that remaining nonconforming parts can be replaced in the course of regular maintenance and attrition. 11/ Furthermore, about $8.0 million has been allocated so far to improving conformity among the engines. Perhaps most important, the Air National Guard has said that the aircraft have so far posed no maintenance problems. 12/ Guard mechanics are generally much more experienced than their active-force counterparts; they also tend to work on the same plane and so become familiar with its individual quirks. Nonetheless, the Guard's experience should moderate concern about the Air Force's ability to maintain KC-135E aircraft.

The KC-135E and the Reserve Forces

In sum, the refurbished E version of re-engining is available earlier at about 20 percent of the cost of the R version, and with 40 percent of the increase in capacity. Yet the Administration has never requested the refurbished E version, perhaps because the E has been viewed as diluting support for the more capable R program. Since 1982, JT-3D re-engining has been undertaken only at the direction of the Congress and has been designated only for tankers in the Air National Guard and Air Force Reserve. These are the oldest tankers in the fleet, and they were scheduled to receive CFM-56 re-engining last. Funds have been approved to provide all 128 Guard and Re-

11. Conversation at Oklahoma City Air Logistics Center, December 6, 1984.

12. Meeting with Air National Guard representative, February 7, 1985.

serve aircraft with JT-3D re-engining, with the last modifications to be completed in calendar year 1986. In addition, about 20 special mission aircraft have been modified with JT-3Ds, including the aircraft used by the Commander-in-Chief of the Strategic Air Command.

The Reserve Forces play an important role in the tanker mission, representing about 23 percent of the Air Force's aerial refueling capacity. 13/ They are more experienced, since most of their people have served on active duty. This is reflected in a higher "mission-capable" rate than for the active-duty force: 76 percent, in comparison with 65 percent. A disadvantage follows from their part-time status, however. Most Reserve personnel have other careers, hence less flexibility, than their active-duty counterparts--particularly with respect to "alert" commitments and overseas task forces. Heavier reliance on the Reserves also increases the chances that they would be needed in lesser crises than a major war; calling up the Reserves during such crises, though legally permissible, can be politically difficult.

Despite the differences in the active-duty and Reserve forces' abilities, the Congress has shown interest in substituting Reserve for active-duty personnel. The Reserves have also shown enthusiasm for the less expensive, JT-3D re-engining program. This suggests one option treated in Chapter III.

New Aircraft--the KC-10 Advanced Tanker/Cargo Aircraft

In the early 1980s, the DoD sought to expand tanker resources by taking advantage of the added capacity of new-generation wide-body commercial transports. The KC-10, a military version of McDonnell Douglas's DC-10, was the winner of a competition. Besides improved range and payload, the KC-10 offered the special attraction of being able to serve two functions--as tanker and cargo carrier. To date, however, the KC-10 has been procured mainly to augment the cargo fleet. 14/ At present, 36 KC-10s are in the Air Force's inventory, and delivery of another 24 is planned to be completed by 1987.

Nonetheless, the large KC-10--with a maximum gross takeoff weight of 590,000 pounds, compared to 297,000 pounds for a KC-135A--offers sub-

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13. Bennie J. Wilson, ed., *The Guard and Reserve in the Total Force* (Washington, D.C.: National Defense University Press, 1985).

14. Although less efficient as a cargo carrier than other cargo carrier aircraft, such as the C-5, 60 KC-10s would be capable of augmenting the airlift fleet by as much as 9 percent.

stantial capacity as a tanker as well as an airlifter. It is also an entirely new plane, rather than a refurbished existing one, which may mean a longer period before the Congress would have to invest in a still newer tanker.

Not surprisingly, the KC-10 costs substantially more than either re-engining program. The average purchase price per plane (not including military construction) is $74.1 million, over three times the investment cost of modification with the CFM-56 engine, the costlier of the two re-engining choices. Current operating and support costs are also significantly higher than for any KC-135, but only because the KC-10 is now operated largely as though for the airlift mission. The demands of airlift call for three crews per aircraft, compared to 1.27 crews for the tanker mission. With additional crews, the KC-10 is flown upwards of 400 hours a year, compared to around 305 for the KC-135. If further KC-10s were procured as dedicated tankers, they could be operated with the tanker crew ratio of 1.27 crews per aircraft, as with the KC-135s and operated the same number of hours per year. This would yield only somewhat higher operating and support costs than for the re-engined tankers--about $2.9 million per year, or $600,000 more than the CFM-56 re-engined tanker.

The KC-10 can carry more than 355,000 pounds of fuel, or almost twice as much as the KC-135A. Its fuel delivery capacity averages about three times that of the unmodified KC-135, depending on the range and mission assigned to it. It is equipped with both a boom (the long tube that most aircraft use to accept fuel in the air) and a hose and drogue (used mostly to refuel fighter aircraft), so that it can refuel several types of aircraft on one mission. 15/

When used as a tanker, the KC-10 is particularly effective in deploying fighter planes overseas, since it can carry much of a fighter squadron's personnel and equipment while also conveying fuel. The KC-10 could also be very effective in support of strategic bomber missions--especially the more fuel-intensive ones--because its large fuel-carrying capacity gives it greater relative efficiency at longer ranges. On the other hand, since the current KC-10s were purchased primarily for conventional airlift operations, they were procured without certain features that the Strategic Air Command insists are requirements for the strategic mission. An example is a quick start ability that allows rapid engine start and takeoff. Future procurement could include these features at no additional cost. 16/

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15. The KC-135 can also refuel fighter aircraft that require a hose and drogue, such as those in the Navy and with NATO allies, but an adapter kit must be installed on the ground beforehand. The KC-10's capability is built in.

16. McDonnell-Douglas has offered to add these features provided it has a minimum commitment for 24 additional aircraft.

TABLE 2. RELATING TANKER COSTS AND CAPACITY--INVESTMENT AND ANNUAL OPERATING AND SUPPORT COSTS (Costs in millions of dollars, capacity in tanker equivalents)

Modernization Approach	Capacity Improvement per Unit Added	Units Needed to Add One Tanker Equivalent to Fleet	Investment Costs		Tanker Equivalents Per Unit Operated	Operation and Support Costs	
			Per Unit Procured	Per Tanker Equivalent Procured		Per Unit	Per Tanker Equivalent
KC-135A (Baseline)	--	--	a/	a/	1.0	2.5	2.5
KC-135R	0.5	2.00	20.8	41.6	1.5	2.3	1.5
KC-135E	0.2	5.00	4.1	20.5	1.2	2.3	1.9
KC-10	3.0	0.33	74.1	24.5	3.0	2.9	1.0
KC-10 if Replacing KC-135A in Fleet	2.0	0.5	74.1	37.1	--	--	--

SOURCE: Congressional Budget Office.

a. Procurement of the basic KC-135A was completed in the early 1960s.

Should the Congress plan to buy more than the full complement of 60 now planned for purchase through 1987, it must act soon. Although final assembly will still be in the works through 1987, without long-lead money in 1986 for additional aircraft orders, the production line will soon close for new orders; subcontractors will have completed their work on long-lead items for the current order. Thus, the opportunity to buy a new tanker, for which research and development costs have been largely amortized, may soon disappear.

HOW THE APPROACHES MEASURE UP IN COST EFFECTIVENESS

How much improved aerial refueling capacity can investment dollars buy? The answer to this question--essential in assessing the relative merits of the approaches--lies in what it costs to add a given unit of capacity (a tanker equivalent) to the fleet. By investing $20.8 million in a KC-135R, for example, the Air Force can add one-half of a tanker equivalent to the fleet (see Table 2). To increase capacity by a full tanker equivalent, the Air Force would have to spend $41.6 million on two KC-135Rs. By this measure, the KC-135E, costing a modest $4.1 million per unit purchased, is the most economical approach. Though five KC-135Es would have to be purchased (because one E modification adds only 0.2 tanker equivalents), the investment cost for a full additional tanker equivalent would come to only $20.5 million, or $21.1 million less than for the R version. Again by this measure, the expensive KC-10, surprisingly, can be more cost effective than the KC-135R, despite its $74.1 million purchase price per aircraft. For that sum, the Air Force can add three tanker equivalents. If a KC-10 is merely added to the fleet, its investment cost per single added tanker equivalent is just $24.5 million; if instead it replaces a KC-135A, its unit price per tanker equivalent rises to $37.1 million, closer to but still less than the investment cost of the KC-135R.

In comparing operating and support costs, this ranking changes--although the differences among them are significantly smaller, less than $1 million a year. In these terms, the KC-10 emerges as the most economical choice and the KC-135E as the least. The KC-135R falls midway between. Compared to the annual $2.5 million the Air Force now spends on upkeep for its KC-135As, any of these tanker improvements offer cheaper operation and support.

CHAPTER III

OPTIONS FOR IMPROVING TANKER RESOURCES

Consideration of how to proceed with upgrading the tanker fleet must focus primarily on three issues:

- **Modernization** -- How soon would modernization efforts allow the Air Force to phase out its operationally hampered KC-135As?
- **Timing and Capacity** -- How would the pace toward the tanker fleet's minimal needed improvement mesh with projected demand?
- **Cost** -- How much money can realistically be committed to tanker modernization--especially in light of recent efforts to curb growth in defense spending?

In deliberating about how to continue improving the fleet, the Congress will inevitably face some tradeoffs. Maximum capacity and optimal timing, for example, may be achievable only at high cost. More moderate expenditures might still purchase the capacity needed, but perhaps too late. And better pacing might be managed for still less money, but at appreciable sacrifice in aerial refueling capacity. Narrowing the debate to any one of the modernization approaches now under way can worsen the effects of such tradeoffs. The Congressional Budget Office has therefore studied options that entail combinations of these approaches.

WHY MIX THE MODERNIZATION APPROACHES?

No one of the approaches described in Chapter II can fully satisfy the concerns noted above. Depending on the KC-135R alone would mean high costs and likely slow progress. In contrast, depending only on the KC-135E could be quite economical and timely, but would not produce so much long-run improvement in tanker capacity. Turning exclusively to the KC-10, while achieving appropriate capacity and promptness, might be so costly as to invite a backlash effect further delaying and/or scaling down modernization efforts.

Each of the alternatives to the Administration's program that the Congressional Budget Office has examined, therefore, features combinations

of the approaches. The options are distinguished by the emphases they place on each modernization approach; none relies solely on one approach. (Table 3 displays the procurement profiles for each option.) One alternative mix--emphasizing JT-3D re-engined KC-135Es--provides modestly greater capability in the near term and significantly faster modernization at a lower cost than does the Administration's program. A variation of that option, and really a first step toward it, Option IIA looks at some additional transfer of KC-135Es to the Reserve forces, with whom the KC-135E has been very popular. Another alternative mix, emphasizing additional procurement of KC-10s, offers substantially more capability than the Administration's program for similar costs.

Basis for the Analysis

To depict the overall capacity achievable by enacting each option (see Table 4), the CBO has used the Air Force's procurement commitments through 1985 as the status quo of the aerial refueling improvement effort. That is, analytic assumptions for all options include prior authorizations for re-engining 102 KC-135R tankers, 128 KC-135E tankers in the Reserve forces, and continued multi-year procurement of 60 KC-10 tanker/cargo aircraft to be completed in 1987. The CBO has also applied Air Force estimates for comparing the aircrafts' capability, which is based on their average fuel-delivery capacity relative to that of the unmodified KC-135A over an average mission distance. By this method (as noted in Chapter II), the Air Force estimates the KC-135R to be a 50 percent improvement over the unre-engined KC-135A, or the equivalent of 1.5 KC-135As. The KC-135E is considered the equivalent of 1.2 KC-135As. And the KC-10 is considered the equivalent of three KC-135As.

These estimates have certain significant limitations. As averages, they are fairly sensitive to the diverse ranges of missions assigned to the fleet. In analysis, the large KC-10 tanker/airlifter, for example, shows a relative improvement of less than 200 percent for missions of shorter distance and greater than 200 percent for longer missions, on which its sizable fuel-carrying capacity can be fully exploited. Also, as the number of re-engined tankers increases, or as overall demand declines, the marginal contribution of each improved tanker declines.

OPTION I. THE ADMINISTRATION'S PLAN EMPHASIZING THE KC-135R TANKER

Initiated in 1977, the Administration's plan for 1986 through 1990 emphasizes the KC-135R tanker featuring the powerful new CFM-56

TABLE 3. PROCUREMENT UNDER THE OPTIONS, FISCAL YEARS 1986-1993

Options and Items Procured	1986	1987	1988	1989	1990	Subtotal 1986-1990	1991	1992	1993	Total 1986 to Completion
Option I										
CFM-56 Re-engining Kits	43	50	50	72	72	287	72	53	--	412
KC-10 Aircraft	12	8	--	--	--	20	--	--	--	20
Option II										
CFM-56 Re-engining Kits	36	36	36	36	36	180	7	--	--	187
JT-3D Re-engining Kits	33	48	48	48	48	225	--	--	--	225
KC-10 Aircraft	12	8	--	--	--	20	--	--	--	20
Option III										
CFM-56 Re-engining Kits	30	30	30	30	30	150	--	--	--	150
JT-3D Re-engining Kits	30	48	48	48	26	200	--	--	--	200
KC-10 Aircraft	12	8	8	8	8	44	8	8	8	68

SOURCE: Congressional Budget Office.

NOTES: Actions up to 1986 include approved purchases of 102 KC-135R re-enginings, 128 JT-3D re-enginings, and 40 of the total planned purchase of 60 KC-10 tanker/cargo aircraft.

TABLE 4. COMPARISON OF THE OPTIONS: CAPACITY, PERCENT MODERNIZED, AND INVESTMENT COSTS, FISCAL YEARS 1986-1995 (Capacity in tanker equivalents, costs in billions of 1986 dollars)

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Option I. The Administration's Plan Emphasizing the KC-135R Tanker										
Tanker Capacity	843	895	912	934	958	989	**1,025**	1,043	1,097	1,105
Percent Modernized	35	40	45	51	58	67	77	87	98	**100**
Investment Costs	1.27	1.13	1.02	1.42	1.45	1.39	0.99	0.03	0.03	0.00
Option II. Emphasizing the KC-135E Tanker										
Tanker Capacity	846	908	934	962	989	**1,011**	1,029	1,038	1,038	1,038
Percent Modernized	37	49	61	73	85	92	97	**100**	100	100
Investment Costs	1.29	1.04	0.93	0.92	0.95	0.18	0.02	0.00	0.00	0.00
Option III. Emphasizing the KC-10 Tanker/Cargo Aircraft										
Tanker Capacity	836	908	958	**1,006**	1,039	1,063	1,082	1,096	1,096	1,096
Percent Modernized	37	49	61	72	85	91	96	**100**	100	100
Investment Costs	1.18	1.30	1.24	1.29	1.24	0.46	0.38	0.22	0.00	0.00

SOURCE: Congressional Budget Office.

NOTES: Actions up to 1986 include purchase of 102 KC-135R re-enginings, 128 KC-135E re-enginings, and 40 of the planned total purchase of 60 KC-10 tanker/cargo aircraft. Numbers in bold type indicate capacity at or above the benchmark demand estimate of 1,000 tanker equivalents, and completed fleet modernization.

engine. As of its February 1985 budget, the Administration planned to have funded re-engining for 287 KC-135Rs in 1986-1990 (see Table 3). Testimony suggests that, in later years, the Administration has plans for continued conversion until the entire fleet consists of KC-135Rs, plus the 60 KC-10s now being introduced. 1/ This study assumes that, in the years beyond 1990, re-engining of KC-135As with the CFM-56 would continue to completion at the maximum planned pace of 72 aircraft a year, for a total purchase of 412 KC-135R tankers in 1986 and beyond. The active-force tanker fleet would consist of 514 KC-135Rs, including 102 that were authorized before 1986.

Under this plan, total tanker force capacity would grow gradually, surpassing the benchmark of 1,000 KC-135A equivalents in 1992--after the likely peak of tanker demand has passed. Modernization would also proceed, though slowly. By 1990, 58 percent of the fleet would have been modernized with some form of re-engining. Modernization would be completed only as late as the mid-1990s.

The Administration's option has the advantage that it calls for purchase of a new engine that can furnish the greatest added refueling capability per re-engined aircraft. The CFM-56 modification also meets commercial noise limits and provides the greatest air pollution abatement.

At the same time, the Administration's option is expensive. Over the next five years, it would cost $6.3 billion, requiring substantial real growth in spending on tankers. Costs to complete all re-engining and KC-10 procurement under the likely Administration's plan would come to $8.7 billion. Yet, despite growth in the defense budget over the last several years, and despite emphasis on modernizing strategic forces, fiscal constraints and competing priorities in weapons systems have caused the CFM-56 tanker re-engining program to be cut back both by the Congress and the Department of Defense. 2/ The re-engining program of fiscal year 1983, for example, was designed to have funded 334 re-engined aircraft by the end of 1988, but the current program will have bought just 245 by that date (Table 5 compares the two programs). Whereas the original program planned to build

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1. In testimony before the Senate Armed Services Committee, February 1982, Secretary of the Air Force Verne Orr stated, "Over the long-term, the Air Force plans to re-engine all KC-135As with the CFM-56 engine."

2. In fiscal year 1985, the Congress cut back the request for 31 re-engining kits to "at least" 24. With the funds available, the Air Force procured 30 kits. In fiscal year 1985, after the "Rose Garden" budget compromise, the DoD cut back the original re-engining request from 65 kits to 36. Expressing concern both about fiscal constraints and the tanker shortfall, the Congress, in turn, directed that 43 kits be procured.

TABLE 5. COMPARISON OF ORIGINAL AND CURRENT ADMINISTRATION PROGRAMS FOR KC-135R RE-ENGINING (In numbers of units procured)

Fiscal Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	Total 1982-1990
1983 Plan	10	19	31	65	65	72	72	--	--	334
1986 Plan	10	19	30	43	43	50	50	72	72	389

SOURCE: Congressional Budget Office.

up to a maximum re-engining rate of six aircraft a month (72 a year) by 1987, current plans--assuming no further cutbacks--will not achieve this rate until 1989. High costs could continue to impede the program if, as in recent years, the Congress seeks to curb growth in defense spending.

Continued slowdowns in the Administration's option would exacerbate its major fault: lack of timeliness. Already out of synchrony, the peak of demand and completion of the buildup in tanker capacity would be separated still further. Furthermore, the fleet would have to operate with unmodified KC-135As beyond the mid-1990s. As important, the basic KC-135 airframe now being re-engined is continuing to age, and by the mid-1990s, it will be about 35 years old, making continued investment in expensive KC-135R modifications increasingly less economical.

OPTION II. EMPHASIZING THE KC-135E TANKER

Stressing the KC-135E instead could avoid some of these problems of high cost and mistiming. As noted in Chapter II, because the KC-135E modification relies on aircraft that have, at least for now, lost their commercial economic value, it is both inexpensive and quick. The average $4.1 million cost of JT-3D re-engining is about one-fifth that of CFM-56 re-engining, and the six-month turnaround period from funding to delivery is also one-fifth the time. This option would take advantage of emphasizing both re-engining programs to yield cost-savings, faster modernization of the fleet, and somewhat greater near-term tanker capacity.

Under Option II, CFM-56 re-engining in most years would continue at the rate of three per month, close to its recent rate, for a total of 187 KC-135Rs over the period 1986-1991--225 fewer than envisioned in the Administration's likely plan (see Table 4). At the same time, 225 JT-3D re-enginings would proceed at a rate of four per month. This would complete re-engining of the 412 remaining KC-135As.

In the near term, overall tanker capacity under Option II would be modestly higher than under Option I, and the 1,000-tanker-equivalents benchmark would be passed a year sooner. The rate of modernization would be markedly improved over the Administration's program, with 85 percent of the fleet modernized by 1990 and all of it by 1993.

Moreover, costs would be lower. Five-year investment costs would be reduced by about $1.2 billion, and total program savings would amount to about $3.4 billion. This would help hold down growth in defense spending. (Table 6 compares investment costs of the alternatives relative to the Ad-

TABLE 6. ANNUAL INVESTMENT COSTS OF THE ALTERNATIVES RELATIVE TO THE ADMINISTRATION'S PLAN, 1986 TO COMPLETION (In billions of 1986 dollars)

	1986	1987	1988	1989	1990	Subtotal 1986-1990	Total to Completion a/
Option I							
Administration Plan	1.27	1.13	1.02	1.42	1.45	6.29	8.73
Incremental Costs or Savings (-) Compared to Option I b/							
Option II	0.02	-0.09	-0.09	-0.50	-0.50	-1.16	-3.40
Option III	-0.09	0.17	0.22	-0.13	-0.21	-0.04	-1.43

SOURCE: Congressional Budget Office.

a. Procurement completion dates: Option I, 1992; Option II, 1991; Option III, 1993.

b. Five-year discounted investment costs (at 4 percent discount rate) for the Administration's plan are $5.79 billion; discounted savings for Option II equal $1.0 billion; and for Option III, $0.0 billion.

ministration's plan.) A possible requirement for a technologically advanced tanker, suited to accompany ever more advanced bombers or to serve in increasingly taxing missions, might also argue for holding down current investment. 3/

The success of Option II would depend on the availability of suitable "donor" aircraft--the retired commercial 707s that furnish parts for KC-135Es. As the option is envisioned, less than half of the remaining worldwide supply (see Chapter II) would be needed. This should make the option feasible, even though some airlines might decide to keep these aircraft in commercial use by buying hush kits for them. Furthermore, U.S. aircraft manufacturers now have economic incentives to clear some foreign commercial markets of 707s to make way for new aircraft sales. They might be helpful in acquiring donor aircraft for the Air Force.

But the option has drawbacks, too. Aircraft re-engined with the JT-3D engine cannot meet the current noise and air pollution abatement standards regulating commercial domestic flight, while those refitted with the CFM-56 engine can. This would certainly be a detriment at air bases near large civilian centers. There is also concern that the age and nonuniformity of the recycled JT-3D engines would make them difficult to maintain. But to date, the Air National Guard has reported no problems of this kind.

Over the long run, this option would provide somewhat less capability than the Administration's program because the JT-3D does not offer the full performance improvement of the CFM-56. As reported in Chapter I, however, analysis indicates that demand will decline in the latter years of the projection period after peaking around 1990. If this picture were to change significantly, a fallback would still be available--namely, that the CFM-56 production line would still be open.

Implementing this option would mean putting JT-3D re-engined aircraft in the active-duty forces for the first time, and some Air Force officials have expressed concern that this would complicate logistics by requiring new training and new stocks of spare parts. The latter might not be a problem, in that the basic JT-3D engine now powers the B-52H bombers, AWACS surveillance planes, and other aircraft already in the active-duty force. Furthermore, two active-duty bases are already collocated with Air

3. Possible technological upgrades include reduced "radar signatures" (detectable elements) and/or defensive avionics. Although some of these modifications could be made to current tankers, it is more likely that such extensive investment would be made in new aircraft.

National Guard JT-3D aircraft, and three more are collocated with JT-3D equipped Air Force Reserve units. 4/ Thus, basing KC-135Es together with these aircraft might actually exploit economies of scale for spare parts and technical support. Having KC-135Es in the active-duty force would also allow for backup aircraft for the Guard and Reserve, which will soon have all KC-135Es; if the Reserve forces were to lose a KC-135E in a peacetime accident, a replacement would be readily available from the active fleet, as was the case when both active and Reserve forces had KC-135As.

Though having KC-135Es in the active-duty force might complicate training for different versions of tankers, how much is difficult to say, especially in comparison with training complications called for by the Administration's plan. By 1990, under this option, the active fleet would consist of a mix of KC-135E and KC-135R aircraft. Under the Administration's plan, though, a mixed fleet of KC-135As and KC-135Rs would persist well into the 1990s.

While re-engining some aircraft with the JT-3D has many advantages and seems to have few insurmountable drawbacks, JT-3D re-engining has never been formally supported by the active Air Force. It has, however, been supported by the Air National Guard, all of whose aircraft will--when purchases made in 1985 are delivered--have JT-3D engines. The Congress could take the first step toward Option II by placing more of the tanker capability in the Reserves and re-engining those added Reserve aircraft with the JT-3D.

Option IIA. Redistributing Tanker Capacity Using the KC-135E

The Guard currently has 13 KC-135 tanker units, and the Reserve has three. Each unit has eight tankers of which one is on alert for the strategic mission at all times. As cited in Chapter II, Major General Conaway of the Air National Guard has testified that "robusting" Guard units from eight to a minimum of ten aircraft each would allow a unit to maintain two tankers on alert at all times. With ten aircraft, the ratio of Reserve force support tankers to mission-available tankers would improve from 8 to 1 to 5 to 1, a more efficient use of existing assets.

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4. The current Air Force basing plan has B-52H aircraft stationed at the following bases: K.I. Sawyer, Minn., Dyess, Tex., Carswell, Tex., Ellsworth, S. Dak., and Minot, N. Dak. Colocated bases in the Guard are Pease, N.H., and Fairchild, Wash.; in the Reserves, Grissom, Ind., Mather, Cal., and March, Cal.

One approach to building up the reserves would be to eliminate two of the 32 active-duty tanker squadrons. The 32 aircraft thus withdrawn from active duty would be re-engined with JT-3D engines and distributed among most of the Guard and Reserve units, so that each had ten tanker aircraft.

Two units, at Pittsburgh and Milwaukee, currently cannot accommodate ten tankers without increasing ramp space and other infrastructure. But 14 units could be augmented with two tanker aircraft each. The remaining four tankers could be used either as backup for the Reserve forces or to establish a permanent tanker unit in Alaska to support air defense and reconnaissance missions. At present, active-duty force tankers rotate to Alaska on a temporary basis, increasing the burden on their squadrons' remaining personnel and tankers. A permanent Reserve mission there could partly alleviate the drain on active-duty personnel to support the Alaskan tanker task force.

Permitting a first step toward Option II, total savings compared to the Administration's plan from re-engining the 32 aircraft with the JT-3D would be about $370 million. But, savings in any year compared to Option I would depend on the rate of concurrent KC-135R re-engining. With these aircraft in the Reserve forces, operating and support costs would increase by $20-30 million a year, eventually offsetting the investment savings--in 10-20 years. 5/ But there are also some additional advantages. One might be improved readiness. On the basis of the two-year average of 1983-1984, the Guard's "mission-capable" rate is about 76 percent, compared to 65 for the active-duty force. (Mission-capable rates measure the time that aircraft are not "mission-limited" by requirements for either supplies or maintenance.) In general, the Guard benefits from having more experienced personnel to fly and maintain its aircraft; hence the improved readiness. More important, there would be a net addition of four to six aircraft to the total force able to stand constant alert for the strategic mission, because the Reserve forces could make more efficient use of their aircraft. 6/

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5. Although military personnel costs decrease, they are more than offset by increased operating and maintenance costs from additional flying hours--392 versus 305--and civilian technicians required by the Reserve forces.

6. Another approach would achieve the benefits of robusting--namely, more alert aircraft--though it would provide no new candidates for JT-3D re-engining. Under this approach, the mission of two Guard and Reserve units now using JT-3D aircraft would be changed and their aircraft would be used to robust the remaining units. Although this would provide no advantages from a re-engining perspective, neither would it offer any of the drawbacks associated with impacting active force missions.

This option is not, however, without drawbacks. The availability of fewer active-duty aircraft would make it harder to carry out some types of commitments. For instance, the active-duty forces assume proportionately more of the peacetime support and training missions than do the part-time Reserve and Guard. In some cases such as overseas missions, which regularly have unavoidable delays, it might be difficult to substitute Guard or Reserve personnel, who must be back at their civilian jobs, for active-duty forces. At a minimum, scheduling would become more difficult. Furthermore, as reliance on the Reserves increases, presidential authority to respond to a military conflict diminishes because of the fixed limit on Reserve forces a president may call upon.

These drawbacks might not be quantitatively important, however. Under this option, only about 25 percent of all KC-135 tankers would be in the Reserve or Guard, compared to about 20 percent under the Administration approach. This modest increase might not greatly complicate planning, though a farther-reaching reassignment of aircraft to the Reserves might.

OPTION III. EMPHASIZING THE KC-10 TANKER/CARGO AIRCRAFT

With increased reliance on the new KC-10 aircraft, the Air Force could satisfy the competing demands of expanded aerial refueling capacity and timeliness. Neither Option I nor II meets the benchmark of 1,000 KC-135A equivalents until the 1990s, by which time tanker demand is forecast to slacken. By economizing on a mixed re-engining program and applying most of the savings toward an enlarged KC-10 purchase, Option III would go far toward addressing the near-term problems of tanker shortages.

Specifically, rather than buying 412 KC-135Rs, this option would have 150 tankers in the active-force fleet re-engined with the new CFM-56 and 200 with the refurbished JT-3D engines over the 1986-1990 period. With the savings relative to the Administration's plan, 48 additional new KC-10 tankers would be purchased between 1988 and 1993 (see Table 2). At the same time, because of the capability afforded by the KC-10, as well as the higher operating and support costs of these additional tankers, 62 KC-135As would be retired without being re-engined as KC-10s came into the force. As noted in Chapter II, the KC-10's large fuel-carrying capacity makes it particularly efficient as a tanker for very long missions, such as those supporting some strategic bombers--especially bombers carrying external cruise missiles for "shoot-and-penetrate" missions (see also Chapter I). Thus, the 48 KC-10s would be procured and operated as dedicated tankers

equipped for the strategic mission. This, along with retirement of the KC-135As, would obviate the need for additional crews. More important, each KC-10 put into the strategic role could free up about three KC-135 tankers for conventional missions, for which an increase in sheer numbers of tankers--or "booms"--can be as important as a particular tanker's capacity. Here, greater numbers of tankers allows for more flexibility and efficiency in scheduling and operations.

This option would provide the most capability in the near term, and about the same capability as the Administration's plan over the long term. The tanker fleet would reach the benchmark figure of 1,000 tanker equivalents by 1989, three years sooner than would the Administration's plan, and 85 percent of the force would be modernized by 1990, compared to 58 percent under the Administration's plan. Also, this option would incorporate a new, modern tanker, which might postpone for more years the need to buy a still newer tanker.

Finally, adopting Option III would keep a tanker production line open into the 1990s, which would be critical if security requirements dictated a rapid increase in the size of the tanker fleet. As a tanker/cargo aircraft, an open production line for the KC-10 also offers opportunities for increased airlift capacity, a constant concern to all of the services.

This option would not, however, reduce costs below the Administration's five-year plan--a clear drawback. In fact, costs would actually rise in years 1987 and 1988, which might be a problem in light of near-term limits on funding (see Table 6). However, over the long run, this option would save about $1.4 billion compared with likely Administration plans.

REDUCING TANKER DEMAND--APPROACHES TO IMPROVE EFFICIENCY

As the Congress assesses various ways to add to aerial refueling capacity, the Air Force could also consider ways to economize by reducing demand for tanker support. Though any such course would entail some sacrifice of military capability, a few are outlined here to highlight the flexibility possible at the policy and planning level.

Rising tanker demand could be offset considerably by forgoing the taxing "shoot-and-penetrate" mission and having only "stand-off" missions for B-52s. This would, of course, reduce the target coverage from successful penetration missions.

Demand could be reduced further by retiring some of the B-52s sooner than the Air Force now plans to do. Such a course would probably be considered seriously only if an arms control agreement were secured.

The Air Force could be more selective in its planned use of aerial refueling, and could revert to ground refueling at en route bases for some combat aircraft. Among the likeliest candidates would be fuel-intensive fighter aircraft (notably F-4s) designated for conventional combat in Europe. One result would be greater tanker capacity available for use elsewhere. Another, however, would be sacrifice of autonomy and promptness for those combat aircraft forced to depend on midcourse land refueling. In a major war with many participants, U.S. aircraft would most readily find other nations prepared to offer midcourse land refueling. But at the same time, it is in such a major war that the need for airborne refueling might also be most acute.

Increasing planned wartime "utilization rates" would allow each tanker to fly a few more hours per day during combat, thus expanding the effective capacity of the fleet. Some Air Force officials believe that, even with monthly and quarterly restrictions on crew flying time, there is some flexibility to increase these wartime rates, especially since re-engined tankers should require less maintenance and support. This conclusion, however, is not uniformly agreed on, and some peacetime investment in stocks of spare parts and support might be needed to allow for more wartime flying.

In sum, while alternatives to reduce tanker demand exist, all involve military or political risks--or indeed, added costs--that DoD apparently believes do not outweigh the benefits.

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PROTECTING THE TEXTILE AND APPAREL INDUSTRIES

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This report analyzes the economic effects of legislation (H.R. 1562) that would provide further protection to the textile and apparel industries. It was requested by Congressman Sam M. Gibbons, Chairman of the Subcommittee on Trade of the House Committee on Ways and Means, and Congressman Philip M. Crane, the Ranking Minority Member of that Committee.

This report was written by Daniel P. Kaplan and Peter Siegelman, both of CBO's Natural Resources and Commerce Division, under the supervision of David L. Bodde and Everett M. Ehrlich. The authors would like to thank Steven Parker of CBO's Fiscal Analysis Division and Lewis Alexander of the Federal Reserve Board for their valuable comments. Kathryn Quattrone prepared the manuscript for publication and Frank Pierce edited it. Inquiries regarding the report should be directed to the authors at (202) 226-2951.

PROTECTING THE TEXTILE AND APPAREL INDUSTRIES

INTRODUCTION AND SUMMARY

This paper discusses the effects of further protection for the textile and apparel industries, both on the industries themselves and on the economy as a whole. H.R. 1562 would place limits on imports of textiles and apparel that would go beyond the restraints already negotiated under the Multifiber Arrangement (MFA). The MFA specifies the means by which a country can limit imports of textile and apparel products that are made of cotton, man-made fibers, or wool. Currently, two-thirds of textile and apparel imports are covered by some type of quantitative restriction. In contrast, H.R. 1562 would limit imports of textile and apparel from all countries, save the European Community and Canada. It would also expand the types of textile and apparel products that are restricted, and further limit future growth of imports.

The effects of further restrictions on textile and apparel imports have recently been investigated in two other analyses--one by Data Resources, Incorporated, and one by the International Business and Economic Research Corporation. These analyses should be considered within the context of how an economy adapts to a decision to limit imports of a product. Initially, the reduction in the supply of imports increases the price of the restricted products. Most of the increased cost to consumers of protected products is transferred to textile producers and their suppliers and does not represent a net cost to the economy as a whole. The higher prices for imported products increase the demand for domestic substitutes, which increases their prices and, in turn, domestic output. In the short run, the higher prices result in increased returns to textile and apparel producers and possibly to their suppliers and employees as well. In the long run, the protected industries adjust to the restrictions, and the redistributive effects of the higher prices will be more widely diffused. Restraints on imports also reduce the number of employees and the amount of other resources that will leave the protected industries; they thereby reduce the costs of adjusting to increased import competition. For example, protection will allow some workers to avoid spells of unemployment and the costs of finding other jobs. But in the absence of protection, almost all of these workers would eventually find other employment.

Protection does more than benefit producers at the expense of consumers of the protected product; it also imposes an efficiency loss on the economy. By limiting the imports of a product, society's resources are diverted from other productive activities to producing more of the protected product. Domestic resources would be more productively employed in the other uses, because foreign producers can manufacture the imported product at lower costs. By discouraging the employment of resources in their most highly valued use, protection thus encourages the inefficient use of the economy's resources and reduces social welfare.

The loss of efficiency resulting from trade restraints continues as long as the restraints remain effective. Moreover, in the long run, consumers continue to pay higher prices for the protected products. On the other hand, the benefits of protection that come from enabling labor and capital to avoid adjustment costs are one-time savings; these benefits do not continue to be realized in the long run.

The DRI Analysis

An analysis by Data Resources, Incorporated (DRI) estimates the effects of "the absence of any U.S. action (against further textile and apparel imports)" on total output and employment in the textile and apparel industries and, in turn, on the economy as a whole. It is not an explicit simulation of the effects of H.R. 1562. DRI estimates that "action against" further textile and apparel imports would save 947,000 jobs in the textile and apparel industry by 1990. Moreover, DRI estimates that there would be 1.89 million more jobs overall in that year. Gross national product (GNP) in 1990 would be 0.8 percent higher. DRI's results were released in a three-page summary--neither DRI nor the client for whom the study was undertaken, Burlington Industries, made the complete analysis available to CBO.

These results were derived under what appear to be a number of restrictions. Specifically, DRI's analysis appears to have been limited to the positive effects associated with higher domestic textile and apparel production. These benefits exist, but there are concomitant costs as well. Protection for the textile and apparel industries would raise the U.S. price level and lower the purchasing power of U.S. consumers. Import restrictions would reduce the incomes of foreign textile and apparel exporters and, therefore, reduce their ability to buy U.S. goods and services. Changes in textile and apparel imports of the magnitude suggested by the DRI analysis could result in changes in the exchange rate that would penalize other U.S. exporters. Similarly, if DRI is correct in estimating greater employment in the protected industries, the resulting labor-market adjustments could lead to less employment in other industries.

These "feedback" effects appear to be omitted from the DRI analysis. It may be the case that the positive output and employment effects that DRI estimates would precede, in some instances, these economic losses. In the long run, however, the positive and negative effects of textile and apparel protection would be largely offsetting--import restrictions would change the composition of GNP more than its ultimate level. Moreover, the DRI analysis does not take account of possible retaliation by countries disadvantaged by H.R. 1562. Such retaliation would unambiguously lower income and welfare in the United States.

The IBERC Analysis

A second analysis, conducted by the International Business and Economic Research Corporation (IBERC) for the Retail Industry Action Coalition, addresses H.R. 1562's effects on prices, output, and employment in the textile and apparel industries and the retail sector. IBERC estimates smaller effects in the textile and apparel industries than does DRI. IBERC estimates that, in the first year following its enactment, H.R. 1562 would lead to a combined job savings in textile and apparel of about 71,000 employees. It further maintains that there would be no additional job savings in subsequent years. These job savings, in IBERC's view, would be almost offset by declines in employment in the retail sector. IBERC estimates that the employment benefits to textile and apparel workers would be worth about $300 million, while the cost to textile and apparel consumers of further protection would be approximately $2.9 billion, all in the first year following enactment. In addition, the economy would suffer a deadweight loss--the cost of using resources inefficiently--of about $474 million.

CBO's Analysis

The magnitude of these effects is uncertain, however, and relies on assumptions regarding the nature of the textile and apparel markets. To investigate the effect of alternative assumptions, IBERC's results were recalculated under a range of assumptions regarding textile and apparel supply and demand. Under this range of assumptions, the cost of the restrictions to consumers of textile and apparel products would range from $1.4 billion to $6.9 billion in the first year following implementation, while employment-related benefits would range from $0.2 billion to $0.9 billion.[1] IBERC's estimates of these costs and benefits--$2.9 billion and $0.3 billion, respectively--are at the low ends of these ranges. The deadweight efficiency losses resulting from the quotas would range from $183 million under the most favorable assumptions to $579 million under the least favorable ones.

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1. This estimate does not take account of possible changes in exchange rates and in the prices of other goods.

H.R. 1562 AND THE MULTIFIBER ARRANGEMENT

Recent developments in the U.S. textile and apparel industries have aroused widespread concern. Production has grown sluggishly, and total employment fell by 10 percent in textiles and 3.7 percent in apparel between 1980 and 1984. Technical progress and new investment have increased productivity, but at the cost of further declines in employment.

These industries' problems have been compounded--some have argued, caused--by a surge in imports. Between 1980 and 1984, textile and apparel imports rose by 108 percent, or 20.1 percent per year. This followed a period of eight years during which imports fell by 3 percent per year. 2/

Import competition is not a recent development in the two industries, and the import surge of the past four years has taken place despite a long-standing international system of protective quotas. But import growth between 1980 and 1984 has led to calls for increased protection to preserve output and employment in the face of foreign competition. This section provides background on the existing and proposed systems for protecting the textile and apparel industries.

History of Protection in Textiles

Restrictions on textiles have expanded from a single country's exports (Japan), a single fiber (cotton), and a relatively small number of textile products to a global system of restraints. Textiles were among the first manufacturing sectors to receive special protection. France, the United Kingdom, and the United States had Voluntary Export Restraints (VERs) in place against Japanese cotton textiles before World War II. By the mid-1950s, both the United States and the United Kingdom had again negotiated VERs with Japan for cotton textiles. In the early 1960s, however, several other newly industrializing countries--especially Hong Kong, Korea, and Taiwan--began to take advantage of the gap created by Japanese restraints.

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2. These figures are for imports in "square yards equivalent" (SYE), a measure of the physical quantity of imports that permits aggregation of various textile and apparel products. For example, a men's dress shirt might equal 2 SYE while a bed sheet might be 12 SYE. When computed in value terms, the growth rate of imports is slightly higher, reflecting a shift by foreign exporters into more highly valued output.

This spread of import competition led the United States to call a conference of textile importing and exporting countries, under the auspices of the General Agreement on Tariffs and Trade, or GATT, to negotiate a set of rules for trade in cotton textiles that would prevent "undue disruption of established industries." The Short Term Agreement Regarding International Trade in Cotton Textiles went into effect in 1961 and was followed by a Long Term Agreement (LTA) in 1962. The LTA was essentially a set of rules that countries were to follow in negotiating bilateral agreements. A key feature was that in situations of market disruption, as defined by the agreement, bilateral agreements could be negotiated to limit exports or restrict imports. 3/ Such measures were conceived as temporary, however, and restraints were to be set at no less than the previous year's import level with at least 5 percent per year growth to be allowed for the life of the restraint. Under the LTA, the United States and other developed countries entered into numerous bilateral agreements with the major exporters of cotton textiles. For the United States, the number of such agreements jumped from one (with Japan) in 1962 to 30 in 1972.

The Multifiber Arrangement 4/

Two related developments undermined the LTA and led directly to its successor, the Multifiber Arrangement, or MFA. The first was technological change in the textile industry, specifically the development of synthetic fibers. The second was the spread of synthetics production to the newly industrialized countries and Japan, as well as the strong demand for synthetics in the developed countries. Products of synthetic fibers or cotton/synthetic blends were not covered by agreements under the LTA, and the rapid

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3. "Market disruption" was said to occur if there was: (a) rapid growth in imports of a given product; (b) prices substantially below those for domestic substitutes; and (c) serious damage (actual or threatened) to domestic producers.

4. The complete text of the MFA and some subsequent ammendments may be found in *The Multifiber Arrangement, 1980-84*, U.S. International Trade Commission Publication 1693, May 1985, Appendix A. The report also contains a valuable compilation of statistical materials on U.S. textile trade. A useful history of the Arrangement may be found in *Textile and Clothing Industries*, O.E.C.D. (Paris, 1983) Annex III.

growth of such imports was a cause for concern, especially in the United States. 5/ This led to new negotiations regarding these fibers.

In 1971 and 1972, the United States negotiated bilateral "voluntary" export restraint agreements covering wool and synthetic products with the major exporters--Japan, Hong Kong, Korea, and Taiwan. Since such agreements were outside the framework established by the LTA, a new agreement was needed, and the Arrangement Regarding International Trade in Textiles, also known as the Multifiber Arrangement, or MFA, was created as a result.

The MFA, which came into effect in 1974, attempted to balance the potentially conflicting needs of importers and exporters of textile products. Philosophically, however, it was conceived in the GATT tradition of trade liberalization. The MFA establishes rules for the operation of textile and apparel quotas. It defines the circumstances under which such restrictions are justified, and sets out procedures for establishing restraints. With certain exceptions, restraints are meant to be negotiated bilaterally between importing and exporting countries, to be temporary, and to cover only those products that threaten injury to domestic producers. In certain emergency situations, the MFA allows unilateral imposition of temporary trade restraints; these are considered to be a serious exception to the general principles of the Arrangement. Since its inception, the MFA has been renewed twice, and is currently scheduled to expire in 1986.

Under the guidelines of the MFA, the United States has negotiated bilateral agreements with 26 countries. Moreover, there are, as of 1985, four additional agreements with non-MFA countries and seven cases in which the United States has unilaterally imposed restraints, for a total of 37 restrained countries. Imports subject to these restraints amounted to about two-thirds of textile and apparel imports in 1984. 6/ In addition to quantitative restrictions under the MFA, textiles had the highest tariff protection of any of the major product groups in 1977, as illustrated in Table 1. Since 1977, textiles and apparel tariffs have been granted special exemptions under the subsequent "Tokyo rounds" of GATT-sponsored tariff reductions.

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5. In 1964, U.S. imports of cotton fiber clothing amounted to 415 million square yards equivalent (MM SYE), as compared with synthetic fiber clothing imports of 92 MM SYE. By 1972, the proportions were reversed: 545 MM SYE of cotton to 1606 MM SYE of synthetics. Between 1960 and 1979, the share of synthetics in world fiber production rose from 5 percent to over 36 percent. Source: Institute for International Economics, unpublished document, 1985.

6. U.S. International Trade Commission, "Memorandum to the Committee on Finance of the U.S. Senate on S.680" (August 1985).

TABLE 1. TRADE-WEIGHTED TARIFF RATES FOR U.S. IMPORTS, BY MAJOR TSUS CATEGORIES, 1977

Category	Tariff Rate (In percent)
Schedule 1: Animal and Vegetable Products	3.79
Schedule 2: Wood and Paper; Printed Matter	1.69
Schedule 3: Textile Fibers and Textile Products	22.85
Schedule 4: Chemicals and Related Products	1.09
Schedule 5: Non-metallic Minerals and Products	5.14
Schedule 6: Metals and Metal Products	3.55
Schedule 7: Miscellaneous	7.98
Average on All Products	3.73

SOURCE: Federal Trade Commission, *Staff Report on Effects of Restrictions on United States Imports* (1980).

An MFA agreement places limits on the volume of textiles and apparel that a country may export to the United States in a given year. The limits cover specific products (such as mens' cotton knit sweaters), as well as more general restraints (for example, cotton knits of all kinds). Only textile and apparel products of three fibers--cotton, wool, and synthetics--are controlled under MFA agreements. 7/

From the point of view of the United States and other importing countries, the purpose of MFA agreements has been to protect domestic produc-

7. Other fibers--notably silk, linen, and ramie, a cotton-like fiber--are exempt from MFA regulation.

tion and employment in the textile and apparel industries. But a major goal of the Arrangement has always been to insure access to markets for textile-exporting countries. Hence, the MFA specifies that bilateral agreements should include measures to alleviate some of the burdens that restrictions would otherwise impose on exporters. Subject to modification under special circumstances, restraint agreements are therefore supposed to allow for export growth of 6 percent per year for each commodity or commodity group. 8/ They are also supposed to be as narrow as possible in their product coverage and include so-called "flexibility" provisions. In the context of the MFA, "flexibility" means that exporters may "swing" some share of a quota from an underutilized category to one for which the quota is binding, or borrow and lend quotas between years for the same category.

The Import Surge

As demonstrated in Table 2, while imports for most textile and apparel products grew rapidly in the four years following 1980, they actually declined in the preceding eight years. Total imports rose by 20.1 percent per year from 1980 to 1984, as compared to a 3 percent per year *decrease* between 1972 and 1980 and an increase for the 12 years as a whole of only 4.2 percent per year.

The significant appreciation of the dollar--60 percent between January 1980 and March 1985--has certainly contributed to the surge of textile and apparel imports. 9/ But growth in textile and apparel imports has occurred despite the presence of MFA agreements limiting import growth to 6 percent per year, and significantly less than this rate for many categories of products from many countries.

There are four explanations for this phenomenon. First, 1980 was an unusually low year for imports, owing to the recession and the weak U.S. dollar. But growth in quotas occurs regardless of the behavior of actual imports over the course of a year--U.S. imports of a given product from a given country could fall by 10 percent in any one year, but the relevant quota would still rise by the amount negotiated in the agreement. Thus, growth in excess of a negotiated rate may occur if the initial level of

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8. In fact, many of the agreements limit the rate of growth in certain categories to significantly less than 6 percent per year.

9. The textile import weighted average exchange rate appreciated by 51 percent between 1980 and 1984.

TABLE 2. ANNUAL PERCENTAGE GROWTH RATES OF TEXTILE IMPORTS: 1972 THROUGH 1980 AND 1980 THROUGH 1984

	Yarn	Fabric	Apparel	Made-Ups	Total
Cotton					
1972-1980	-8.9	-3.0	7.9	-1.3	1.0
1980-1984	30.4	21.0	14.6	28.2	19.3
Wool					
1972-1980	-3.2	1.9	2.7	-5.5	1.3
1980-1984	45.0	28.1	14.2	17.3	19.1
Synthetics					
1972-1980	-20.0	-5.4	1.3	3.9	-5.4
1980-1984	36.3	18.9	12.3	54.7	20.8
Total					
1972-1980	-18.4	-4.0	3.3	0.6	-3.0
1980-1984	35.4	20.3	13.2	41.5	20.1

SOURCE: Calculated from U.S. International Trade Commission Publication 1549.

NOTE: Growth rates calculated from imports in square yards equivalent.

imports has previously fallen short of the amount allowed under the agreement, creating "slack" in the quota. But such "excess" growth cannot be sustained. If imports start from a low base but grow more rapidly than the quota, they must eventually catch up to the maximum amount permitted under the quota, after which point they can grow only by the negotiated rate each year. Thus, it may be possible to find some years during which import growth rates exceeded the maximum allowable negotiated rate. But over the long run, import growth cannot exceed the negotiated rate. Moreover, despite recent rapid growth, total textile and apparel imports in 1984 were 81 percent of the level they would have reached if they had grown by 6 percent per year since 1972.

A second explanation focuses on the "flexibility" of quotas. Since importers can "swing" some share of a quota from an underutilized category to one where the quota is binding, or borrow and lend quotas between years, it is possible for the growth rate of imports in certain categories or certain years to exceed the negotiated rate. Borrowing from next year's quota, however, can only increase the growth rate of imports for one year (even if the borrowed quota is never "repaid"). Similarly, swing provisions cannot affect the long-run growth rate of imports, since they only transfer import rights among import categories.

Table 3 provides an example, using one specific product (cotton trousers), of how such flexibility provisions permitted "extra" imports in 1983. The countries listed are all those that used flexibility provisions for cotton trousers during 1983. Several major exporters are not listed in Table 3 and did not use these provisions, however, and for all cotton trousers imports the ITC calculates that "flexibility accounted for additional shipments of slightly over 1 percent" 10/ (rather than the 5.0 percent that was applicable for the set of countries listed in the table). The use of flexibility varies significantly by country and by product type, and it is difficult to generalize about the overall impact of these provisions. 11/

A third possibile source of import growth is panic buying in advance of expected quotas. Some allege that importers stocked up on products in strong demand, fearing that the rapid import growth that had already occurred would soon trigger the imposition of restrictions.

All of these are essentially transitory phenomena, which suggests that the import surge is unlikely to continue as long as current MFA agreements are in force. The most recent data are consistent with this interpretation. For the first six months of 1985, textile and apparel imports rose by only 1.3 percent over the corresponding period in 1984.

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10. U.S.I.T.C., *The Multifiber Arrangement*, Publication No. 1639 (May 1985), p. 78.

11. The above analysis should not be understood as implying that flexibility provisions have no effects on exporters or on their U.S. competitors. By allowing greater freedom to respond to rapidly-changing market conditions, the flexibility provisions do provide an advantage to exporters (and, conversely, a disadvantage to American firms producing similar products) as compared with a system of fixed quotas.

TABLE 3. COTTON TROUSERS: INCREASE IN IMPORTS PERMITTED BY FLEXIBILITY PROVISIONS, 1983 (In dozens of pairs, and percent)

Country	Original Restraint Level	Restraint Level Adjusted for Flexibility Provisions	Amount of Adjustment (In percent)	Actual Imports	Imports in Excess of Original Restraint Level		Type of Adjustment a/
					Quantity	Percent of Original Restraint	
China	1,782,477	1,871,601	5.0	1,871,601	89,124	5.0	SA
India	200,000	226,000	13.0	223,679	23,679	11.8	SA, CF
Korea	270,807	287,055	6.0	284,401	13,594	5.0	SA
Macau	314,259	331,196	5.4	321,578	7,319	2.3	S, U
Malaysia	173,536	192,625	11.0	157,979	0	0.0	CO
Philippines	501,884	558,402	11.3	531,950	30,066	6.0	CO, SA, U, CF
Singapore	248,077	292,730	18.0	291,908	43,831	17.7	S, CO
Taiwan	909,085	963,630	6.0	885,695	0	0.0	SA
Thailand	196,067	217,634	11.0	217,634	21,567	11.0	CO
Total	4,596,192	4,940,873	7.5	4,786,425	229,180	5.0	

SOURCE: Calculated from U.S. International Trade Commission Publication 1639, Table 41, p. 77.

a. SA = shift added; CF = carry forward granted; S = swing granted; CO = carryover; and U = carry forward used.

A fourth possibility, however, is that growth occurred mostly from uncontrolled sources--that is, from countries, specific products, or fibers for which no restraints currently exist.

Unfortunately, it is extremely difficult to specify precisely how much of import growth has come from uncontrolled products. 12/ As a substitute for product-by-product examination of import growth, one might instead look at imports from "controlled" and "uncontrolled" countries. (Note that not all products from controlled countries are actually subject to restrictions; in this context, "controlled" merely means that the United States has a bilateral agreement or unilaterally imposed restriction governing *some* products from a given country.) An examination of the data for the period 1980 to 1984 reveals that imports from controlled sources amounted to approximately 83 percent of textile and apparel imports in 1984; and that of the total increase in imports between 1980 and 1984, 80 percent came from controlled countries and 20 percent from uncontrolled countries. Thus, although their share of total imports is still quite small, imports from uncontrolled countries have grown more rapidly than those from controlled countries--26 percent per year as opposed to 19 percent per year. 13/

H.R. 1562

A current legislative proposal--H.R. 1562--would strengthen the protection afforded by the MFA. This would be accomplished by expanding unilaterally the commodity and country coverage of trade restraints, reducing both the level and the maximum permissible growth rate of imports, and implicitly eliminating the flexibility found in current bilateral agreements. The bill would also establish restrictions on all products, in advance of a possible import "surge."

H.R. 1562 would expand the coverage of quantitative restrictions to include all textile and apparel products, of all fibers, from all countries (except the European Community and Canada). The bill establishes four classifications for textile and apparel exporters. "Major exporting

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12. As one group of authorities on the MFA put it, "the agreements are so opaque that... informed public debate is precluded." G. Curzon et al, *MFA Forever?* (London: Trade Policy Research Centre, 1981), p. 29.

13. Calculated from U.S. International Trade Commission, *The MFA, 1980-84*, USITC Publication 1693 (May 1985), p. 54.

countries" are those whose share of U.S. imports is greater than 1.25 percent of total imports of textiles and apparel. All other countries are classified as "exporting countries," with the exception of members of the European Community and Canada on one hand and Mexico and other countries in the Carribean region on the other. "Major" exporters together accounted for about 80 percent of total U.S. imports in 1983.

The bill would place limits on textile and apparel exports to the United States, establishing a procedure for calculating reference exports in 1984 and maximum allowable exports thereafter. The procedure varies depending on a country's classification as a "major" or "other" exporter and whether or not the country had an export restriction agreement with the United States.

If the country was a "major" exporter, 1984 reference exports would be calculated as follows. For each category of export products (for example, men's cotton shirts), the level of exports of the product in 1980 is assumed to have grown by 6 percent per year for four years (compared to the average growth rate of all textile and apparel imports of 20.1 percent per year during that period). For products covered by a bilateral agreement that restricts growth to a rate below 6 percent per year, the actual level of exports in 1984 would be observed. The smaller of these two amounts would be the 1984 reference level of exports. Allowable exports in 1985 would be 101 percent of 1984 reference exports, and for future years the permissible growth rate would be fixed at 1 percent per year. For other exporters, 1984 reference exports are calculated as 115 percent of actual 1984 exports in a given product category, unless such exports accounted for more than 40 percent of U.S. production of items in that category. In these "import sensitive categories"--roughly 40 percent of total imports by volume in 1983--reference exports would be 101 percent of actual exports in 1984. Exports from "other exporters" would be restricted to 6 percent growth per year in 1985 and thereafter, or 1 percent per year for "sensitive" products. (Note, however, that if an "other" exporter achieves a market share of more than 1.25 percent, it would be treated from then on as a "major exporter," with an allowable growth rate of no more than 1 percent per year.) Exports from members of the EC and Canada would not be restrained, and those

from Caribbean Basin countries would be accorded somewhat more favorable treatment. 14/

The rapid growth of imports over the last four years implies that for many products, and for most major suppliers, actual imports in 1984 exceeded the 1984 reference level established by the bill. Hence, the bill would require an overall decrease in the *level* of imports, as well as a decrease in their future rate of growth. In addition to the substantive changes described above, the bill would represent a significant change in the procedural form of protection. It would replace the current system of restraints (negotiated product by product and country by country) with a general system, unilaterally imposed by the United States. Although the bill would require differential treatment for "major exporters," "exporters," and other countries, it would not allow for distinctions among various products or among individual countries within a group.

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14. The more liberal treatment of imports from the Caribbean Basin would limit somewhat the quotas' adverse impact on United States producers who use Section 807 of the tariff schedule. Under Section 807, a United States firm that exports components ready for assembly without fabrication can subtract the value of the American components in calculating the duties when the assembled products are imported. Imports of these items, however, are generally limited by existing quotas. A number of domestic firms export cut fabrics and then import completed apparel under Section 807. Imports under Section 807 amounted to about 4 percent of total textile and apparel imports in 1984.

For the year ending May 1985, 78 percent of the Section 807 imports were from Caribbean countries or Mexico. In addition, imports from Canada, which are not affected by the bill, accounted for 4 percent of Section 807 imports. The Caribbean countries and Mexico would be treated relatively favorably by H.R. 1562 in two ways. First, these countries would not be considered "major exporters" even if their aggregate quantity of textiles and textile products exceeded 1.25 of all imports of these products. Thus, under the provision of the bill, exports from these countries would not initially be reduced and would be permitted to grow at a rate of 6 percent per annum. Second, in no case would exports from the Caribbean countries and Mexico be considered "import sensitive products." For other countries, products for which the ratio of total imports to domestic production exceeded 40 percent would be considered import-sensitive, and the growth of exports of these products would be limited to 1 percent per year. Nevertheless, some domestic firms' Section 807 operations have grown quite rapidly and their future growth would undoubtedly be constrained by the provisions of the bill.

MACROECONOMIC EFFECTS: THE DRI ANALYSIS

DRI analyzed the effects of higher levels of textile and apparel imports by comparing two alternative simulations of its macroeconomic model, one in which the market share of textile and apparel imports was held constant over the next five years and one in which it was allowed to grow at a rate of 20 percent in the first year, declining to 10 percent in the fifth. This latter assumption was presumed to represent the rate of textile and apparel import growth without further restrictions.

Under these assumptions, DRI's simulations predict that restricting textile and apparel imports to the rate of growth of U.S. consumption would save 947,000 jobs in the textile and apparel industries by 1990, and that 1990 employment in the entire economy would be 1.89 million greater than under the assumed higher rate of import growth. As a result of higher textile and apparel output, gross national product would be 0.8 percent higher, while the federal deficit would be $24 billion lower in 1990, according to DRI.

The DRI simulations, however, appear to have been made under a number of restrictive assumptions that strongly influence the results. These can be divided into two groups: assumptions about textile and apparel import growth, and assumptions regarding the nature of the economy's response to higher import levels.

Import Growth

DRI assumed that textile and apparel imports would grow by an average of 15 percent annually over the next five years. This is an extreme assumption. DRI based this assumption on the fact that imports have grown at a fairly high rate--roughly 20 percent a year--since 1980. But, as discussed above, this growth rate is the product of several unique circumstances. Given these circumstances, it is unlikely that the DRI assumption would obtain.

The Response to Higher Import Levels

In the DRI simulations, higher textile and apparel import levels lead to correspondingly lower levels of domestic textile and apparel output and employment. This in turn reduces national income and leads to reductions in the production of other goods.

In assessing the economywide implications of higher import levels, the first step is to analyze the extent to which higher imports will affect domestic production. DRI assumes that apparel imports grow by 15 percent per year, and maintains that in such a case, imports' share of the apparel market would reach 80 percent of 1990. 15/ Given that imports of apparel currently have a market share of about 33 percent, 16/ DRI's analysis implies that domestic production would fall at a rate of more than 20 percent per year over the next five years, and, that consumption would fall by almost 5 percent over this period. DRI's results thus require that domestic production fall by *more* than the increase in imports, which is implausible. DRI's assumptions regarding the growth of imports and domestic production are crucial for many of DRI's results, and they are apparently imposed on the model, rather than being generated by it.

Whatever the magnitude of their negative effects on the domestic textile and apparel industries and on the rest of the economy, higher imports also have positive effects on GNP and employment. These positive effects may or may not immediately counterbalance the negative ones, but they do exist, and appear to have been excluded from DRI's analysis. In general, these effects concern the composition of the economy. If imports displace domestic textile and apparel production, then resources--both human and physical--will shift into the production of other goods and services, increasing output and employment in those sectors of the economy. Although there are costs associated with the movement of resources among sectors of the economy, it is this very process of displacement through which trade conveys benefits. This change in the composition of the U.S. economy resulting from increased textile and apparel imports has apparently been ignored in DRI's simulation.

The changes in the composition of the economy would result from at least four factors. First, higher import levels would raise the incomes of exporting nations. These higher incomes increase purchases of other U.S. goods and services that can be exported competitively. Second, higher levels of textile and apparel imports would lower textile and apparel prices in the United States, which would increase consumers' real incomes and could lead to larger purchases of other U.S. goods and services including

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15. The apparel market is presumably defined as apparent consumption of apparel, which is equal to domestic production plus imports less exports.

16. Measured in physical units. When measured in dollar value, imports' market share is only 17 percent, since imported apparel sells for less per square yard equivalent than domestic apparel.

textiles and apparel. Third, increased textile and apparel imports of the magnitudes suggested by DRI would have a depreciating effect on the dollar. A decline in the dollar's value would increase the competitiveness of other U.S. goods and services in world markets. Finally, labor markets may be sufficiently flexible over the long term that other sectors of the domestic economy would be able to employ the displaced workers.

Given the omission of these effects, the DRI results can at best be viewed as a partial depiction of the effects of increased imports. Moreover, since the omitted effects all move in the same direction--that is, they all concern themselves with the salutary effects of higher imports--very little confidence can be placed in DRI's central finding that without further restrictions on textile and apparel imports, increases in output and employment would be significantly slowed. It is more likely that the effects of trade restraints on domestic output and employment would be small, and perhaps negative in the long run.

INDUSTRY EFFECTS: THE IBERC ANALYSIS

The International Business and Economic Research Corporation (IBERC) has performed an analysis of the effects of H.R. 1562 on prices, output, and employment in the textile and apparel industries. This section first summarizes the results of that analysis. It then discusses the key assumptions underlying these results, and presents results derived using alternative values for these key assumptions. Under all assumptions, however, the costs to consumers of textile and apparel products of the quotas suggested by H.R. 1562 are found to substantially exceed their benefits.

Summary of IBERC's Results

Apparel Industry. The International Business and Economic Research Corporation (IBERC) estimated that H.R. 1562 would reduce imports of apparel by 20 percent, and increase imported apparel prices by 16 percent. It further predicted that this price increase would generate a 3 percent rise in demand for domestically produced apparel, and would avert a decline in domestic production and employment of 3 percent (36,141 employees).

IBERC calculated that consumers would pay $2.1 billion more for imported apparel, while the value of the jobs saved would be $106 million. These estimates apply to the first year in which the quotas are in effect. In future years, IBERC calculates that the additional amount consumers pay

for imported apparel because of the quotas would increase at the same rate that the economy expanded, which it assumes to be 3 percent over the next five years. All the quotas' benefits to labor would be realized in the first year, however.

Textile Industry. IBERC estimated that the quotas would reduce the amount of textile imports by 36 percent, which would result in a 33 percent increase in the price of imported textiles. This price increase would result in a 4.7 percent increase in the production of domestic textiles, and a parallel increase in employment of 35,272 employees. Because of the increased prices, consumers would pay $741 million more for imported textiles, while the value of the added employment would be $179 million. As in the case of the apparel industry, IBERC argues that the benefits of quotas would be realized in the first year, while the additional expenditures for imported textiles would increase at the same rate at which the economy grew.

Retail Industries. IBERC found that retail employment would decline because of the quotas. It estimated that the imposition of quotas on textile and apparel imports would result in a reduction of 57,931 jobs in the retail apparel industry and 3,577 jobs in the retail textile industry; it calculated the value of these job losses at $130 million and $8 million respectively.

Government Revenues. Because of the reduction in imports, IBERC calculates that U.S. government would collect $629 million less revenue from its tariffs on imported apparel and $166 million less from its tariffs on imported textiles.

IBERC's Methodology

IBERC's estimates of the effects of the proposed quotas on prices, output, and employment were based on a four-part calculation. First, IBERC translated the language of the bill into a percentage restriction on imports. Second, it estimated the increase in the price of imported textiles and apparel in response to restrictions on their supply and used these price increases to calculate the cost of the quotas to consumers. Third, it estimated the extent to which increased prices for imported textiles and apparel would increase the demand for domestically produced substitutes. Finally, it estimated by how much domestic producers would increase their production and hire more employees as demand for these products increased.

Quantity of Imports. In order to determine the effect of the quotas on the supply of imported textiles and apparel, IBERC assumed that if a country exported any goods in a product category during 1984, it would fill its quota

for that category in 1985 and all future years. IBERC also assumed that if a country did not export goods in a particular product category in 1984, it would not export any such products in 1985 or in the future. Countries in the European Community and Canada, whose exports to the United States are not constrained by H.R. 1562, were assumed not to increase their share of the U.S. market after the bill was passed. Under these circumstances, textile imports would decline by 36 percent and apparel imports by 20 percent under H.R. 1562's provisions in the first year following passage. It should be noted that IBERC's interpretation of the bill leads to a larger first-year import restriction than that assumed in the DRI model, but a smaller one after several years have passed.

Prices of Imported Textile and Apparel. To determine the effect of the reduced quantity of imports on their price, IBERC employed estimates from other analyses of the responsiveness of imported textile and apparel imports to changes in their price (the price elasticity of demand).[18] It cited estimates of the price elasticity of imported apparel of -1.24 and -3.77, and estimates of the price elasticity of imported textiles of -2.43, -1.10, and -0.73.[19] Selecting the less responsive estimate for apparel and the middle value for the elasticity of textiles, IBERC maintains that these values most accurately reflect short-run elasticities, which are relevant for an analysis of the effects of the quota in the first year.

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18. The elasticity of demand measures how the quantity demanded of a good changes in response to a change in its price. Its value is equal to the percentage change in the quantity demanded divided by the percentage change in the good's price. If this ratio is equal to -1.5, for example, then a 10 percent increase in the price of a good will lead to a 15 percent decrease in the quantity purchased. Were the ratio equal to -2.0, then the same 10 percent increase in price would lead to a reduction of 20 percent in the quantity purchased.

19. Margaret Buckler and Clopper Almon ("Imports and Exports in an Input-Output Model," *American Statistical Association*, proceedings of the Business and Economic Statistics Section, 1972, pp. 175-84) estimated the price elasticity of textile imports to be -1.10 and of apparel imports to be -3.77. Joe A. Stone ("Price Elasticities of Demand for Imports and Exports: Industry Estimates for the U.S., the E.E.C., and Japan," *The Review of Economics and Statistics*, vol. 61, no. 2, May 1979, p. 303) estimated that elasticities of imported textile and apparel were -0.73 and -1.24 respectively. William R. Cline and others in *Trade Negotiations in the Tokyo Round: A Quantitative Assessment* (Washington, D.C.: The Brookings Institution, 1978), p. 58, estimated the price elasticity of imported textiles to be -2.43.

With a price elasticity of demand of -1.24, the predicted 20 percent decline in the quantity of imported apparel would lead to a 16 percent increase in the price of imported apparel (-20 percent/-1.24 = 16 percent). Similarly, using an estimate of price elasticity of -1.10, the predicted 36 percent decline in imported textiles would result in a 33 percent increase in the price of imported textiles (-36 percent/-1.10 = 33 percent).

The Cost to Consumers. IBERC maintains that the cost of the quota would be a direct result of the increased prices that consumers must pay for imported products. For those who purchased the imported products at the higher price, the cost of the quota would be simply the additional expense, which would be equal to the resulting price differential multiplied by the quantity imported. This would be a simple income transfer from U.S. consumers to foreign producers. IBERC notes that there would also be a cost associated with those who would have purchased the product at the pre-quota price, but decided not to purchase it (or elected to purchase less of it) at the higher price. This cost is referred to as a "deadweight" or "efficiency" loss. IBERC included it as a cost to consumers, although in a competitive economy this deadweight loss is more accurately considered a cost to the entire economy--it is the cost of using resources inefficiently. As such, it would include the reduction in society's potential to produce goods because resources would be diverted into the production of additional domestic textile and apparel products that could have been imported at less expense. In short, the "efficiency loss" measures the misallocation of resources that would result from the imposition of quotas. IBERC estimated the cost to consumers as equal to $2,386 million for apparel and $950 million for textiles, of which $265 million and $209 million, respectively, would in fact be efficiency losses paid by the economy. 20/

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20. The elasticity estimates that IBERC used measure the relationship between the changes in the price of imports and the changes in the quantities that the *importers* demand. In estimating the cost to consumers of the quotas, IBERC assumed that the increased prices to importers of textile and apparel (the wholesalers, retailers, and apparel manufacturers) would result in an equivalent increase in the price to consumers. Thus, it assumed that a given increase in the dollar amount of an item of apparel would result in an equivalent increase in the dollar amount in the retail price. In the case of apparel, this implies that retailers' gross margins would decline.

IBERC also assumed that the increased cost of textiles would result in an equivalent increase in the price of the final product. This implies that manufacturers using textile products as an input would not use less textiles per unit of output, but simply reduce the amount of the final product that they produced.

Changes in the Production of Domestic Goods. Higher prices for imported textiles and apparel lead to increases in the demand for substitutable domestic goods. The degree to which higher import prices trigger greater demand for domestic goods is called the cross-elasticity of demand for domestic apparel with respect to the price of imports. Since IBERC was not aware of any existing estimates of this cross-elasticity of demand, it derived one based on estimates of related variables. 21/ It concluded that the cross-elasticity of demand is 0.188, and that, therefore, a 16 percent increase in imported textile prices would result in a 3 percent increase (.16 x .188 = .03) in the demand for domestically produced apparel.

IBERC was also unaware of any comparable estimates of the responsiveness of domestic textile demand to the price of imported products. However, a previous study estimated directly the effect of changes in textile imports on the demand for domestically produced textiles. 22/ This study found that a 1 percent decrease in imports would result in a 0.26 percent increase in domestic production. IBERC considered this to be a long-run estimate and halved it to approximate the short-run effect. It concluded that a 36 percent reduction in textile imports would result in a 4.7 percent increase (.36 x .13 = .047) in domestic production.

Changes in Output and Employment. IBERC assumed that the prices of domestic textiles and apparel would not increase and that textile and apparel manufacturers would expand production at the same rate at which demand increased. Moreover, it assumed that employment would expand at the same rate as output. It therefore estimated that output and employment in the apparel industry would increase by 3 percent, and in the textile industry by 4.7 percent. It seems likely, however, that employment would increase at a lower rate than output. In that case, IBERC's assumption would slightly overstate the benefits of quotas.

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21. Specifically, the cross-elasticity of demand can be derived from the price elasticity of demand for domestically produced apparel, imports' share of total consumption, and the elasticity of substitution (which roughly corresponds to the percentage change in the share of imports from a given percentage change in the ratio of the imported apparel price to the domestic apparel price). However, the value of the elasticity of substitution that IBERC used was itself derived from the elasticity of demand for domestically produced apparel and the elasticity of demand for imported apparel.

22. Joseph Pelzman and Randolf C. Martin, "Direct Employment Effects of Increased Imports: A Case Study of the Textile Industry," *Southern Economic Journal*, vol. 48, 1981, pp. 412-426.

In IBERC's view, the primary benefit of H.R. 1562 would be to increase employment in the textile and apparel industries and, more specifically, to keep workers who would otherwise have been laid off employed in the industry. Workers who are laid off do not generally remain indefinitely out of work; they find other jobs. Consequently, protecting a job would allow a worker to be productively employed during what would otherwise be a spell of unemployment. Thus, the value of this benefit would be equal to the wages that employees would earn during what would otherwise have been a period of unemployment.

In the apparel industry a laid-off worker was unemployed for an average of 14.5 weeks in 1984. In the textile industry the average spell of unemployment was 19.7 weeks. IBERC assumed that unemployment in the textile and apparel industries was caused solely by workers being laid off and leaving the industry (although the data probably reflect temporary layoffs as well), and therefore that these spells of unemployment measured the time it took them to find other jobs. IBERC also assumed that the new jobs paid the wage earned in the apparel industry. It then concluded that the benefit of the increased employment resulting from the bill would be worth $106 million in the apparel industry and $179 million in the textile industry. 23/

Related Results

Retail Employment. IBERC estimated the effect of the quotas on retail apparel and textile employment, assuming that employment would decline in these sectors in proportion to the decline in total consumption that would result from the quotas (consumption being approximately equal to imports plus domestic production). It concluded that the loss from reduced retail apparel employment would be $130 million. 24/ The corresponding loss from the decline of employment in textile retailing would be $8 million.

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23. The cost to the workers might be significantly less since they would be entitled to unemployment compensation. The cost to a worker of being laid off would also include any possible negative difference between the income in the new job and what the worker would have earned in the textile or apparel industry.

24. Paralleling the case of the manufacturing industries, IBERC calculated the losses to be the wages forgone during an average spell of unemployment.

Government Revenues. Tariffs on imported textile and apparel products are relatively high. Reducing imports of textiles and apparel would affect the revenues that the government collects from these tariffs. IBERC assumed that the reduction in the government's tariff revenues would be proportional to the decline in the quantity of imports, concluding that a 20 percent reduction in apparel imports would produce a 20 percent decline, or $629 million, in tariff revenues, and that the predicted 36 percent decline in textile imports would mean a corresponding decline in tariff revenues of $166 million.

A Discussion of the Assumptions Underlying IBERC's Analysis

Prices of Domestic Goods. In calculating the cost of quotas on textile and apparel import, IBERC assumed there would be no increase in the price of domestically produced substitutes. This assumption could lead to a substantial underestimate of the costs of the quotas to consumers of textile and apparel products.

An increase in demand for a domestically produced good, whether the result of an import quota or some other factor, will drive up the price of the good. Higher prices for imports lead consumers to switch from imports to domestic products, and the higher demand for domestic products will bid up their prices. In fact, absent an increase in price, there would be no incentive for domestic manufacturers to expand output.[25] In addition, if domestic textile and apparel prices rose in response to the quota, the amount purchased would be less than if they had remained unchanged as IBERC assumed. Thus, domestic output should rise in response to a quota, but by less than the amount that IBERC calculates. As IBERC recognized, ignoring these effects understates the quotas' effects on textile and apparel prices, and overstates the benefits to workers in the protected industries.

Prices and the Demand for Imports. IBERC's predicted change in the price of imported textiles and apparel resulting from the quotas followed directly from its assumption about the elasticity of demand. In selecting elasticities of demand to make these calculations, IBERC cited a number of estimates, and claimed that it chose those that reflected short-run effects.[26] How-

25. For example, textile and apparel manufacturers generally have varying vintages of plants; the newer, more efficient plants tend to operate at higher levels of capacity. Only a rise in the price of textiles and apparel would make it profitable for firms to increase production at their less efficient facilities.

26. Long-run price elasticities are larger than short-run price elasticities, because it takes time for purchasers to respond completely to changes in the relative prices of goods.

ever, this distinction was made arbitrarily. IBERC used Buckler and Almon's estimate of the elasticity of imported textile demand, but not their estimate of the elasticity of imported apparel demand. Both estimates were derived in the same study, using the same methodology; if one is a short-run elasticity, the other is presumably also short-run. 27/ The assumption as to demand elasticity critically affects both the cost of quotas to consumers and the size of the resulting efficiency loss. As the responsiveness of import demand to price declines, the size of these effects will increase.

Increased Demand for Domestic Production. IBERC estimated that a decline of 301 million pounds of apparel imports would result in a 133 million pound increase in domestic production--that is, only 44 percent of the decline in imported apparel consumption would be translated into an increase in domestic production. This result stems from its estimate of the cross-elasticity of demand, which in turn stems from estimates of demand elasticities of domestically produced apparel and imported apparel that were made by different authors covering different time periods. In using these estimates IBERC assumed that domestic and imported apparel are not very substitutable.

In contrast, IBERC's estimate that the increase in domestic textile production would be equal to 80 percent of the decline in imported textiles was based on a direct estimate by Pelzman and Martin of this relationship. IBERC claimed that one-half of their original estimate would be appropriate for a short-run analysis. If the full value of the estimate is used, however,

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27. Buckler and Almon's estimate of the elasticity of demand for imported apparel is higher than the estimate IBERC used. See Buckler and Almon, *Imports and Exports*. If this higher value had been used, the estimated effect of the quotas on the price of imported apparel would have been lower. IBERC did use Buckler and Almon's estimate for the elasticity of demand for textiles.

Buckler and Almon's estimates were derived by constraining the elasticity of demand for imported apparel or textiles to equal the absolute value of the cross-price elasticity of the imported product with respect to the price of the domestic product. Since this is an extreme assumption, Buckler and Almon's estimates should be interpreted with caution. See Morris Morkre, *Import Quotas on Textiles: The Welfare Effects of United States Restrictions on Hong Kong*, Bureau of Economics Staff Report to the Federal Trade Commission, August 1984, p. 66.

IBERC used Joe A. Stone's estimate of the price elasticity of demand for imported apparel, but did not use his estimate of the elasticity of imported textiles. See Stone, *Price Elasticities of Demand*. However, Stone's estimate of the elasticity of imported textiles is smaller than the estimate IBERC used. Had they used Stone's value, its estimate of the cost of the quota to textile consumers would have been greater.

(that is, a 1 percent reduction in the quantity of imports results in a 0.26 percent increase in domestic production), then the increase in domestic production would be 60 percent *greater* than the reduction in imports--the quotas would increase total consumption of textiles. 28/ Such an outcome is extremely unlikely and casts doubt on IBERC's use of the Pelzman and Martin study to measure the effect on domestic production of such a large change in the quantity of textile imports.

The Costs of Unemployment. In its estimates of worker compensation, IBERC excluded employers' contributions to pensions, health insurance, and Social Security, and, therefore understated the job-related benefits of quotas. Moreover, employees incur job search costs that could also properly be included as a cost of being laid off. Finally, the data IBERC cited on the duration of unemployment include temporary as well as permanent lay-offs. It seems quite likely that workers who were permanently displaced would have a longer period of unemployment than workers who were seasonally or temporarily laid off.

Retail Unemployment. IBERC was correct in concluding that the imposition of the quotas would affect the retail sector, which sells textile and apparel products. But just as there are domestic industries that depend on the import trade, there are businesses that provide goods and services to the apparel and textile trade. If the costs to the former are included in the analysis, it would be appropriate to include the benefits to the latter as well.

Government Revenues. In estimating the impact of the quotas on government revenues, IBERC assumed that government revenues would decline in proportion to the quantity of imports. However, tariffs on textile and apparel products are *ad valorem* tariffs; the higher the price of the

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28. Pelzman and Martin concluded in *Direct Employment Effects* that a 1 percent reduction in the quantity of imported textiles would result in an 0.26 percent increase in domestic production. IBERC halved this estimate to reflect the limited response of the domestic industry in the short run.

Textile imports in 1984 were 1,147 million pounds; a 36 percent reduction in these imports, which is the estimated effect of the bill, would imply a reduction of 413 million pounds. Using one-half of Pelzman and Martin's estimate, this reduction would lead to a 4.7 percent increase in domestic production (or 36 percent times .13). In 1984, domestic textile production was 7,109 million pounds. The resulting increase in domestic production would, therefore, be 334 million pounds (7,109 million times .047), or 80 percent of the decline in textile imports.

imported products, the greater the revenues collected on each item. Ignoring the increase in the price of imported products overestimates the reduction in government revenues resulting from the imposition of the quotas.

For example, IBERC estimated that the quotas would increase the price of imported apparel by 16 percent. It also estimated that the quantity of imported apparel would equal 80 percent of what it would have been absent the quota. In this case, the quotas would result in a 7 percent decline in consumer expenditures for imported apparel, and government revenues would be 93 percent of what they would have been absent the quota. This is roughly one-third the revenue loss that IBERC calculated. IBERC similarly overstated the reduction in tariff revenues in the textile industry.

The Long Run. In its analysis of the longer-term effects of the quotas, IBERC assumed that imports would grow at the same rate as the economy, which it assumed to be 3 percent per year. In that case the cost of the quotas to consumers of textiles and apparel, as well as the efficiency loss to the economy, would also grow by 3 percent. However, all the employment gains would be realized in the first year. In this calculation IBERC implicitly assumed that H.R. 1562 would change the level of imports in the first year, but not their future rate of growth. Under this assumption, textile imports would be 20 percent less than they would have been in each year the quotas were in effect. If the quotas limited the future growth of imports over and above the first-year reduction in their level, however, as it seems they would, both the costs and benefits of the quotas in future years would grow more rapidly than IBERC calculates.

First, under H.R. 1562, it is questionable whether foreign textile and apparel manufacturers would be permitted to increase their exports to the United States by 3 percent per year. "Major exporters," who account for the bulk of the sales of imported products, would be limited to a growth rate of 1 percent. 29/ While others could grow more rapidly, they might not be able to grow fast enough to make up the difference. In addition, it is entirely possible that imports would grow significantly above 3 percent per year without the quotas during the next five years. Foreign firms can apparently produce a number of products more inexpensively than domestic manufacturers. Moreover, the current bilateral agreements negotiated under the MFA in many cases permit import growth in excess of 3 percent per year, and these agreements do not apply to all commodities and all countries.

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29. Of course, firms in major exporting countries would attempt to develop means of circumventing the quotas. For example, several Hong Kong apparel manufacturers are establishing factories in Europe; exports from Europe are not affected by the proposed quotas. See "Hong Kong's End Run Around U.S. Protectionism," *Business Week*, August 26, 1985, p. 45.

Because of both of these assumptions, IBERC may have understated the long-term costs of the quotas, both to consumers and to the economy as a whole.

So long as quotas restrict the quantity of imports, they would raise textile and apparel prices. If the quotas continue to limit the growth of imports, then the prices of textiles and apparel would increase more rapidly than they would have increased absent the quotas. If, for example, the quotas increase the price of imported textiles by 16 percent by the end of the first year, they would increase them by more than 16 percent by the end of the second year. The efficiency loss of the quotas would increase more than proportionately with this increase in price. These price increases would be cumulative--if a price rose by 2 percent in 1986 and by another 2 percent in 1987, the price in 1987 would be slightly more than 4 percent above that in 1985.

If the actual future growth of imports were to exceed the growth of imports with the quotas, future domestic production would increase more rapidly (or decrease more slowly) because of the quotas. Thus in each future year the quotas would increase domestic employment. Yet the saving of a job is a one-time saving. There is no additional benefit in 1987 for saving a job in 1986; those workers who would have been displaced in 1986 if a quota had not been imposed would presumably have found other employment a year later. Moreover, it is doubtful that the job savings from imposing the quotas would be anywhere near as large in subsequent years as they would be in the first year, since the major impact of the bill comes from its initial reduction in import quantities.

The efficiency loss to the economy as well as to consumers of textile and apparel products that would stem from the quotas would be cumulative, but the benefits would not. Consequently, the difference between benefits and costs to consumers and the economy would expand in future years, and this expansion would be greater than IBERC calculates.

An Alternative Calculation of the Impact of H.R. 1562

The conclusions of IBERC's analysis of the effects of H.R. 1562 depend on the assumptions underlying its study. To determine the sensitivity of IBERC's estimates, CBO estimated the effects of the proposed quotas under two different sets of assumptions. The first set of assumptions is favorable to the quotas--they produce estimates of the costs to the economy and to textile and apparel consumers that are relatively low, and estimates of the benefits that are relatively high. The second set of assumptions is unfavor-

able to the proposed quotas. These two sets of assumptions are given in Table 4. They were designed to provide an idea of the range into which the quotas' effects would probably fall.

The Alternative Assumptions. IBERC assumed that domestic textile and apparel prices would not change in response to quotas, but it is likely that they would. To incorporate these changes, information on the responsiveness of demand and supply to changes in price is needed. Several estimates exist for demand elasticities. Almon and others estimated that the elasticity of demand for domestic apparel was -0.909 and this estimate was used in the favorable case. 30/ Houthaker's estimate of -0.282 was used in the unfavorable case. 31/ Almon and others estimate an elasticity of -0.133 for textiles; it was used in both cases.

There are no published estimates of the responsiveness of domestic output to changes in price, that is, the supply elasticity. For each industry, therefore, the impact of domestic price and output was computed assuming supply elasticity of 10 in the favorable case (that is, that a 1 percent increase in price would elicit a 10 percent increase in output), and one-half in the unfavorable case. (The Council of Wage and Price Stability assumed that the elasticity of supply ranged between 0.5 and 5 in their 1977 study.) 32/ The true responsiveness of supply is likely to be in this range, although it is probably as high as 10 only in the long run. CBO also assumed that the average price of domestically produced products is equal to the average price of imports. This last assumption is probably conservative, especially in the case of apparel--domestic unit values are probably higher then those of imports. Consequently, the calculations using the alternative assumptions probably understate the cost to consumers of textile and apparel products of the increase in domestic prices.

As discussed previously, there are a number of published estimates of the sensitivity of demand for imported textiles and apparel to changes in

30. Clopper Almon, Jr. and Others, *1985: Interindustry Forecasts of the American Economy* (Lexington, Mass.: Lexington Books, 1974), p. 37.

31. H.S. Houthakker, "New Evidence on Demand Elasticities," *Econometrica 33*, Spring 1965, pp. 277-88.

32. Council on Wage and Price Stability, *Textiles/Apparel: A Study of the Textile and Apparel Industries* (Washington: Government Printing Office, 1973).

TABLE 4. ASSUMPTIONS USED TO CALCULATE EFFECTS OF IMPORT QUOTAS IN THE APPAREL AND TEXTILE INDUSTRIES

	IBERC	Favorable to Restraints	Unfavorable to Restraints
Apparel			
Elasticity of demand for imports	-1.24	-3.77	-1.24
Percentage increase in domestic demand	3	5.4	3
Elasticity of demand for domestic production	N/A	-0.909	-0.283
Elasticity of domestic supply	Infinite	10.0	0.5

	IBERC	Favorable to Restraints	Unfavorable to Restraints
Textiles			
Elasticity of demand for imports	-1.10	-2.43	-0.73
Percentage increase in domestic demand	4.7	4.7	4.7
Elasticity of demand for domestic production	N/A	-0.133	-0.133
Elasticity of domestic supply	Infinite	10.0	0.5

SOURCES: Cited in text.

NOTE: N/A = Not Applicable.

their prices. In the favorable cases the most elastic estimates were used; in the unfavorable cases, the least elastic estimates were used. These are given in Table 4.

IBERC calculated that 80 percent of the reduction in the textile imports would be translated into increased demand for domestic output, and that only 44 percent of the reduction in apparel imports would be translated

into increased demand. In the favorable case, CBO assumed that domestically produced apparel is a better substitute for imports than IBERC concluded and that, as with textiles, 80 percent of reduced apparel imports would be translated into increased demand for domestic apparel. In that case, demand for domestically produced apparel would increase by 5.4 percent rather than 3 percent. With textiles, IBERC's assumption was used in both the favorable and unfavorable cases.

In the favorable case it was assumed that the average spell of unemployment for a displaced textile and apparel worker was double the industry average, which includes some seasonal or temporary layoffs as well as permanently displaced workers. It was further assumed that non-wage compensation and search costs, which were excluded in IBERC's analysis, were equal to 25 percent of the average wage. In the unfavorable case, IBERC's assumption that displaced workers experienced the average spell of unemployment was used.

The Results Under the Alternative Assumptions. Using assumptions that are favorable to restraints leads to larger estimates of the benefits of the proposed quotas and lower estimates of the resulting price increases than IBERC calculated. In the unfavorable case, the opposite is true--the benefits of the restraints are smaller than IBERC's estimates and the costs to consumers and the economy are larger. Even in the favorable case, however, the costs to textile and apparel consumers of the increased prices still exceed the value of the jobs saved in the first year of the program, and the deadweight losses are not averted.

Apparel. Under favorable assumptions, H.R. 1562 creates increased costs to apparel consumers of $0.9 billion (compared to $2.1 billion in IBERC's analysis) and benefits of $0.4 billion (compared to $0.1 billion) in the apparel industry. In addition, the efficiency loss posed by the quotas declines from IBERC's estimate of $265 million to $87 million. In the favorable case, the estimated increase in the price of imports is substantially smaller than IBEC's estimate because the elasticity of demand for imported apparel products is assumed to be substantially larger (see Table 5). Consequently, the cost to consumers of apparel from the increased price of imports is one-third the amount that IBERC estimates. Unlike the IBERC analysis, prices of domestically produced apparel increase in the favorable case; this increase, however, is less than one-half of 1 percent. The 1.5 percent increase in apparel prices, which includes the increased price of domestically produced apparel, is less than one-half IBERC's estimated increase. Moreover, because of the higher demand for domestic production, the number of apparel jobs saved in the favorable case is 63 percent more than IBERC's estimate. In addition, the value of each job saved is more than twice as great.

TABLE 5. COMPARISONS OF COSTS AND BENEFITS OF QUOTAS ON APPAREL IMPORTS UNDER DIFFERENT ASSUMPTIONS (First-year effects)

	IBERC's Results	Alternative Assumptions	
		Favorable to Quotas	Unfavorable to Quotas
Transfer to Foreign Producers			
Percent change in quantity of imports	-20	-20	-20
Percent increase in import price	16.1	5.3	16.1
Transfer to foreign producers (In millions of dollars)	2,121	699	2,121
Redistributive Effects			
Percent increase in domestic price	0.0	0.48	3.8
Percent increase in domestic output	3.0	4.9	1.9
Transfer to domestic producers (In millions of dollars)	0.0	238	1,856
Percent increase in average price	3.3	1.5	6.4
Efficiency Loss (In millions of dollars)	265	87	265
Benefits to Apparel Employees			
Number of jobs saved	36,141	58,898	22,838
Total benefits [a/] (In millions of dollars)	106	430	67

SOURCE: The International Business and Economic Research Corporation (IBERC) and Congressional Budget Office.

a. Derived by calculating the value of compensation for the number and duration of jobs saved.

By contrast, in the unfavorable case, average apparel prices, including imports and domestic production, are assumed to increase by 6.4 percent, which is nearly twice IBERC's estimate. The 1.9 percent increase in production is one-third less than IBERC's estimate. The smaller rise in production is, in large part, due to the assumption that supply is relatively unresponsive. In the unfavorable case, therefore, the costs to apparel consumers of the increased prices is 90 percent greater than IBERC's estimate ($4.0 billion versus $2.1 billion) and the value of the benefits is roughly 37 percent less ($67 million versus $106 million). As compared to the favorable case, the cost to apparel consumers is four times as great and the benefits are one-sixth as large. In addition, the efficiency losses posed by apparel quotas are equal to IBERC's estimate of $265 million in this unfavorable case.

Textiles. In the textile industry, the favorable assumptions lead to costs to textile and apparel consumers of $442 million (as opposed to IBERC's finding of $741 million), and estimates of benefits of the quotas that are more than double IBERC's estimates ($440 million versus $179 million). (See Table 6.) The increase in benefits is due entirely to the increased value of saving a job; there is actually a slight reduction in the estimated number of jobs saved. The costs to textile and apparel consumers of the restraints, despite the increased prices of domestic output, is 40 percent lower than IBERC's estimates. As with apparel this is largely due to the higher estimate of the elasticity of the demand for imports. Nevertheless, under the favorable assumptions the costs to textile and apparel consumers of the quotas still exceed the benefits in the first year of the program. Under the favorable case, the efficiency loss created by the quotas falls from IBERC's estimate of $209 million to $96 million.

In the unfavorable case, however, the average price of textile products increases by 11.3 percent, which is nearly four times the increase in prices that IBERC calculated, and six times greater than the price increase in the favorable case. This is due to a nearly 50 percent increase in imported prices and a 7.5 percent increase in domestic prices. Also, the number of jobs saved is nearly 20 percent less than IBERC estimated. Thus, under the unfavorable assumption, the cost of textile quotas to textile and apparel consumers rises from $740 million (under IBERC's assumptions) to $2.9 billion, while the quotas' benefits fall from $179 million to $141 million. The efficiency loss created by the quotas rises from IBERC's finding of $209 million to $314 million.

TABLE 6. COMPARISONS OF COSTS AND BENEFITS OF QUOTAS ON TEXTILE IMPORTS UNDER DIFFERENT ASSUMPTIONS (First-year effects)

	IBERC's Results	Alternative Assumptions	
		Favorable to Quotas	Unfavorable to Quotas
Transfer to Foreign Producers			
Percent change in quantity of imports	-36	-36	-36
Percent increase in import price	33	15	49
Transfer to foreign producers (In millions of dollars)	741	341	1,115
Redistributive Effects			
Percent increase in domestic price	0.0	0.45	7.5
Percent increase in domestic output	4.7	4.6	3.7
Transfer to domestic producers (In millions of dollars)	0	101	1,794
Percent increase in average price	2.9	1.8	11.3
Efficiency Loss (In millions of dollars)	209	96	314
Benefits to Textile Employees			
Number of jobs saved	35,272	34,638	27,861
Total benefits [a]/ (In millions of dollars)	179	440	141

SOURCE: The International Business and Economic Research Corporation (IBERC) and Congressional Budget Office.

a. Derived by calculating the value of compensation for the number and duration of jobs saved.

OTHER ISSUES

In addition to the questions already discussed, the proposed regulation of textile and apparel imports raises some important issues that were not addressed by either DRI or IBERC.

First, the permanence of the new regulations would represent an important step away from the concept of "adjustment," one of the key notions underlying international trade relations. Under the framework of GATT, countries commit themselves to allowing free access to their domestic markets. When such access permits rapid import growth, which may then prove disruptive to a domestic industry, the country faces an adjustment problem. It may choose to slow down the process of adjustment by temporarily restraining imports, or it may decide to let the process occur at its own speed. Even the MFA, however, does not envisage that adjustment can be stopped altogether--that permanent protection should be instituted to prevent the decline of a domestic industry.

The bill contains no presumption that the protection it offers would be temporary and would be removed once the industries affected regained their competitive position. Rather, it assumes a longer-run inability to compete, and thus weakens the presumption that market forces should ultimately determine the allocation of resources. There have been many instances in which society has altered the process of adjustment to higher imports; but until now, there has generally been a presumption that such adjustment would eventually take place. Other countries, including many textile and apparel exporters, face similar adjustment problems in other sectors. If the U.S. were to abandon the notion that adjustment must eventually take place, the incentives for other countries to allow further import growth would be reduced, and U.S. exports could be expected to suffer as a result.

A second major feature of the bill would be its impact on developing countries. Institutions such as the World Bank and the International Monetary Fund, as well as the U.S. government, have long urged developing countries to follow an export-led growth strategy as the best means of achieving rapid development. The success of such a strategy depends critically on access by developing countries to markets for their exports (especially manufactured exports) in the developed world. By limiting access to the U.S. market for many developing country textile producers, the bill would place an important roadblock in their path to greater prosperity.

The United States has an interest in the further development of the poorer countries that extends beyond altruistic or humanitarian motives. As

such countries achieve higher levels of development, their demand for U.S. exports will increase. Moreover, many such countries are large debtors. In order to repay their international obligations, they must generate foreign exchange earnings by increasing exports (or decreasing imports). If the United States makes it more difficult for countries like Brazil and Indonesia to gain access to its market, it weakens their ability to service their debts.

The bill would also have subtle, but important, effects on economic well-being stemming from its curtailment of variety in the products that are consumed. Imported textile and apparel are not perfect substitutes for domestically produced items: important differences exist in style, fabrics, quality, etc. By restricting the range of choices available to U.S. consumers, the bill would prevent some people from finding the textile or apparel products most suited to their tastes. Moreover, since imported apparel generally tends to be of lower quality and of lower price than domestic apparel, the burden of the quotas would tend to fall disproportionately on the consumers of such products, predominantly the poorer segments of the population.

A further disadvantage to quotas is that they encourage foreign suppliers to upgrade the quality of their products. When restrictions are placed on the physical quantity of imports, producers have an incentive to supply items with a higher price per unit. Foreign products, especially in apparel, have traditionally been at the low end of the quality range; thus, over the long term, the quotas would tend to bring foreigners into more direct competition with U.S. producers in the higher-quality market niches.